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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 11 MAY, 1930 NUMBER 5

PATHOLOGIC CHANGES IN MENINGITIS OF THE INTERNAL EAR *

S. J. CROWE, M.D.

BALTIMORE

The Otological Research Laboratory of the Johns Hopkins University was established about five years ago for the purpose of studying deafness by the correlation of gross and microscopic changes in the middle and inner ear with auditory and vestibular tests for function made before death. The supply of temporal bones is obtained from the pathologic department of the Johns Hopkins Hospital and the Bay View division of the City Hospitals. These two institutions together have about 1,200 autopsies a year. Permission for a complete autopsy is not obtained in every case, but the laboratory receives each year about 275 pairs of temporal bones. These temporal bones are carefully described as they come in, and then decalcified, embedded in a collodion preparation and sectioned serially for microscopic study.

The clinical examination of the ear is not limited to patients with an obvious disturbance of hearing or equilibrium. The correlation in a large series of cases of normal functional tests and normal histologic appearance of the middle and inner ear is essential for the success of this plan of investigation. The greatest difficulty is the preparation of histologic sections that are good enough to make it possible to differentiate the early pathologic changes in the nerves, ganglions and end-organs from artefacts due to poor fixation, decalcification and embedding processes. The endeavor is made, therefore, to have accurate information in regard to the function of the auditory and vestibular apparatus of every patient who comes to autopsy. Such a plan entails an enormous amount of work, but the laboratory organization has so improved from year to year that during the past six months about 50 per cent of the temporal bones received are from cases in which tests were made. During the past five years more than 1,000 pairs of temporal bones have been collected. This material, together with the clinical records in the history, affords an unexcelled opportunity for the study of the hearing and that pathology of the ear in relation to: age,[1] acute infectious diseases, tuberculosis, syphilis,[2] cancer, arteriosclerosis,

* Submitted for publication, Dec. 2, 1929.

* From the Otological Research Laboratory of the Johns Hopkins University.

1. Bunch, C. C.: Age Variations in Auditory Acuity, Arch. Otolaryng. **9**: 625 (June) 1929.

2. Bunch, C. C.: This article is in the course of preparation.

nephritis, the various diseases of the blood, cerebral tumors and infections and disorders of the ductless glands.

My object in this paper is to present photomicrographs of the lesions of the middle and the inner ear in the various types of meningitis that are now represented in the laboratory. These cases illustrate clearly: (1) the extension of otitis media to the labyrinth and meninges by way of the round window, stapediovestibular articulation and fissura ante fenestram, and (2) the extension of primary meningitis to the labyrinth by way of the perineural spaces of the auditory nerve, the perivascular spaces of the modiolar vessels and the cochlear aqueduct.

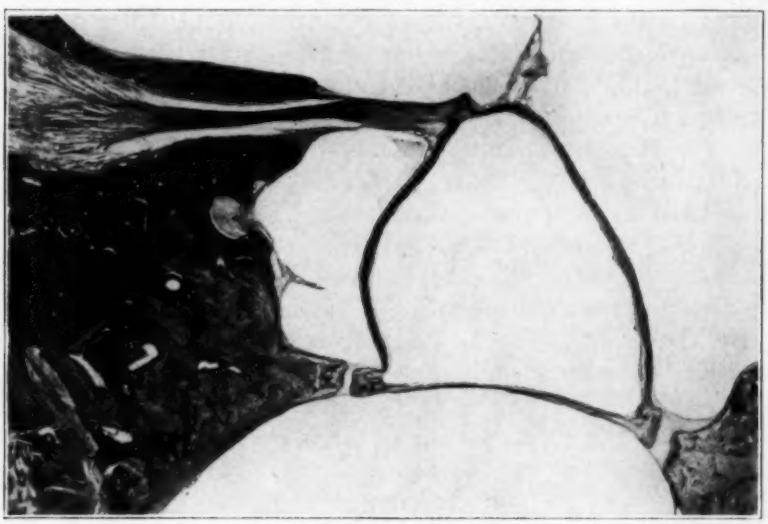

Fig. 1.—Horizontal section through the stapes of a man aged 69. The stapedius muscle, the stapediovestibular articulation and the middle ear mucosa are normal. Compare with figures 5 and 6.

THE STAPEDIOVESTIBULAR ARTICULATION (OVAL WINDOW)

A horizontal section through the stapes of a man, aged 69, is shown in figure 1. The stapedius muscle is seen in the bony canal and at the point of attachment to the stapes. The annular ligament and the overlying mucosa of the middle ear appear normal (compare with fig. 6). The appearance of the normal stapediovestibular articulation and the annular ligament of a child, aged 4 months, is shown in figure 2. A marked thickening and cellular infiltration of the mucous membrane of the middle ear and many inflammatory cells in the annular ligament are seen in figure 3. This patient, aged 10 months, had pneumonia, otitis media, purulent labyrinthitis and pneumococcus meningitis.

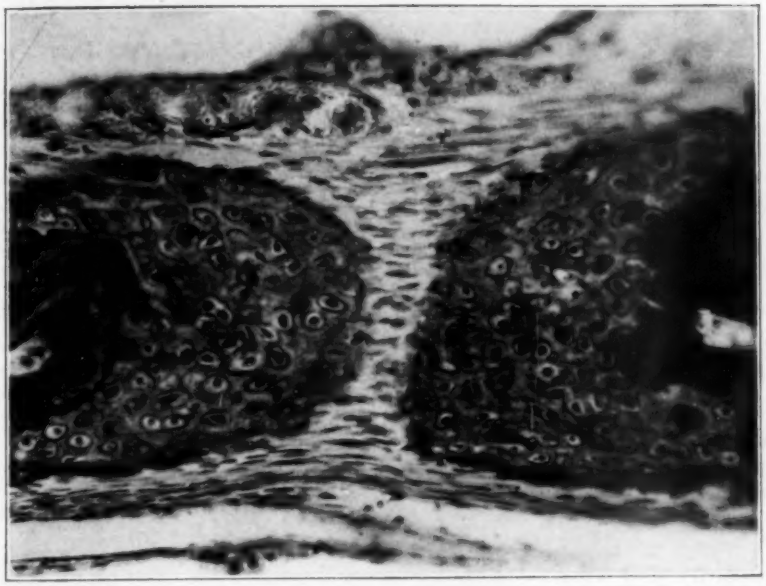

Fig. 2.—A normal stapediovestibular articulation at the age of 4 months.

Fig. 3.—Infection of the stapediovestibular articulation in an infant, aged 10 months, with acute otitis media, lobar pneumonia, suppurative labyrinthitis and pneumococcus meningitis. Figure 10 shows infection of the secondary tympanic membrane of this patient.

Histologic sections were made of every temporal bone that could be secured during the first three years after the opening of the laboratory, in 1924. During this period a large series of specimens from infants were collected. By far the largest percentage of the labyrinthitis specimens were from very young children. Otitis media or meningitis is usually recognized clinically, but serous or suppurative labyrinthitis in an infant has rarely been diagnosed until the histologic sections were made.

The stapes illustrated in figure 4 is from the child, aged 9½ years, who is mentioned in the subsequent discussion of the round window as an example of primary meningitis with secondary involvement of

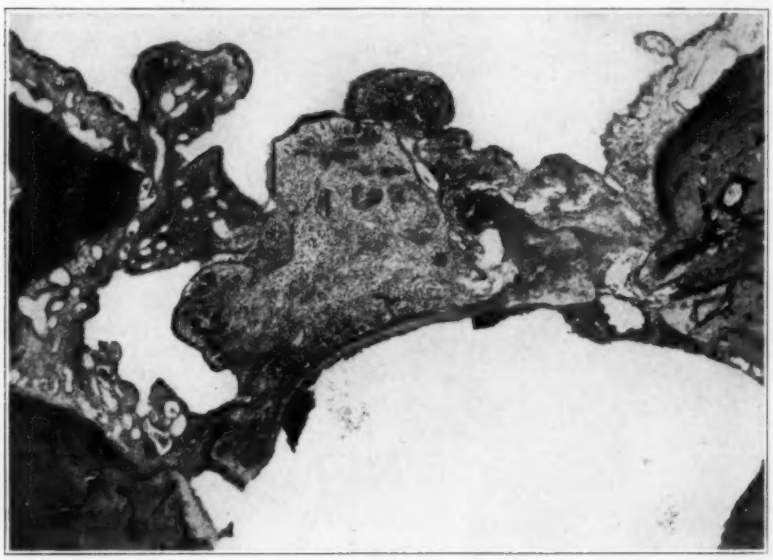

Fig. 4.—Above may be seen the mucous membrane of the middle ear, which is thickened, cystic and infiltrated with inflammatory cells. Necrosis of the stapediovestibular articulation and displacement of the stapes due to increased intralabyrinthine pressure are shown. Figure 20 shows infection in the cochlear aqueduct, and figure 34 destruction of the membranous labyrinth in this case.

the labyrinth and destruction of the secondary tympanic membrane and stapes. This child became ill on February 15 with severe pain in the head and a temperature of 105 F. He was not admitted to the hospital, however, until March 1, and therefore the sequence of events is not clear. It is said that there was no impairment of hearing or clinical evidence of an infection of the ear until after the drums had been incised on February 20. The drums were opened on account of the continued fever and pain in and around the ears, but no pus was found.

Fig. 5.—Changes due to chronic otitis media. The drum is adherent to the promontory, and the middle ear mucosa thickened and cystic. The stapes is embedded in the infected mucous membrane and the secondary tympanic membrane is greatly thickened. Any one of these changes would interfere with the transmission of sound waves to the cochlea.

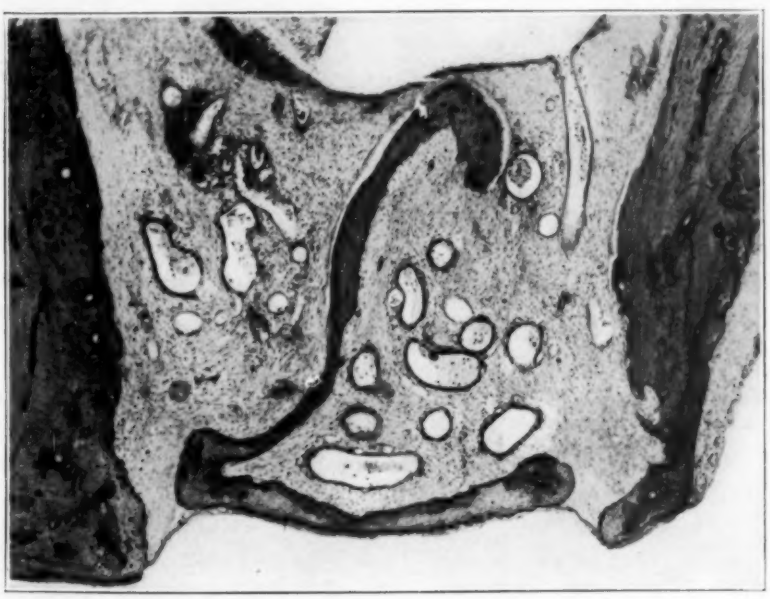

Fig. 6.—Higher magnification of the stapes shown in figure 5.

On February 25 the patient became much worse and complained of loud noises in both ears; within a few hours he became totally deaf. This history, together with the microscopic sections, which show a bilateral purulent labyrinthitis and destruction of the round window membrane and annular ligament of the stapes, suggests that the meningitis was the primary infection. In figure 4 it is seen that the necrosis of the annular ligament is most advanced on the labyrinthine side. The overlying middle ear mucosa is intact. The portal of entry could not be determined. The infecting organism was a mixture of hemolytic and

Fig. 7.—Appearance of normal drum, mucous membrane of the middle ear, stapes, round window, basal coil of the cochlea and utricle in a child aged 11 months. This child had tuberculous meningitis and serous labyrinthitis. Serous exudate is visible on the labyrinthine surface of the secondary tympanic membrane (vertical section).

nonhemolytic streptococcus. Increased intralabyrinthine pressure is indicated by the fact that the stapes is pushed outward into the middle ear (fig. 4).

The changes in the mucosa of the middle ear that result from a long-standing chronic otitis media are shown in figure 5. The remains of the drum are adherent to the promontory. A cross-section of the handle of the malleus is seen above the promontory. The mucous membrane is greatly thickened and cystic, more especially around the stapes and the round window. Figure 12 shows the appearance of the

round window region under greater magnification, and figure 6 the appearance of the stapes. The scar tissue in the middle ear has pulled the stapes outward. This patient was a man, aged 32, who had had discharging ears since infancy and was "very hard of hearing." Other details of his history are mentioned in the discussion of lesions of the round window.

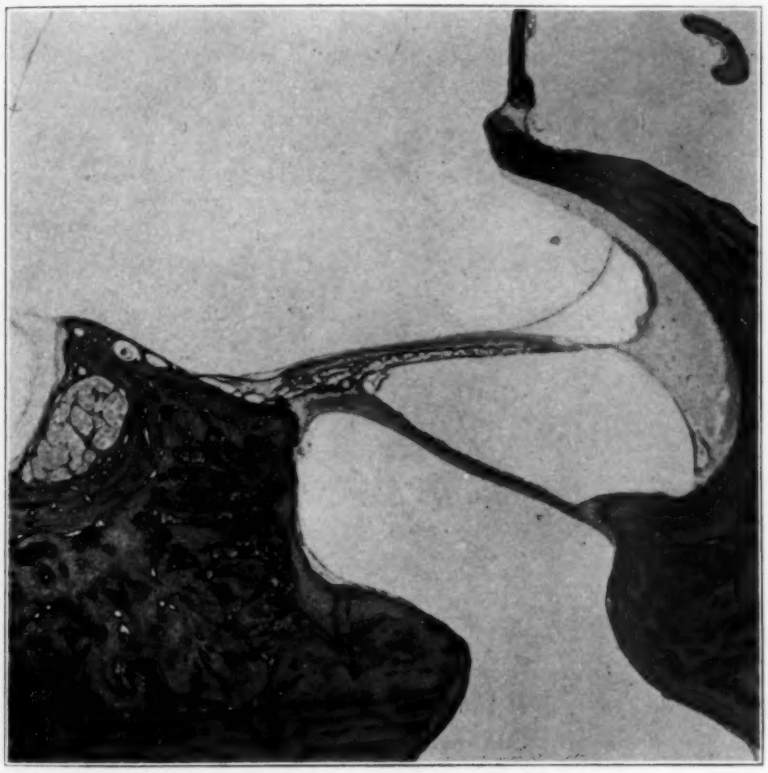

Fig. 8.—The appearance of a normal secondary tympanic membrane in a child aged 4 years.

THE SECONDARY TYMPANIC MEMBRANE (ROUND WINDOW)

A clear idea of the appearance of the normal middle ear is necessary as a basis for comparison with the following illustrations. The tympanic membrane, to which is attached a cross-section of the malleus, the tendon of the tensor tympani muscle, the facial nerve, the stapes, the promontory, the normal thickness of the middle ear mucosa, the secondary tympanic membrane and the relations of this structure to the basal coil of the cochlea and the utricle, are illustrated in figure 7. The

round window is in a recess formed by the bony promontory and is thus protected from injury with a paracentesis knife or from other penetrating wounds of the drum. The mucous membrane of the middle ear covers the outer surface of the secondary tympanic membrane and is an important factor in preventing the extension of otitis media to the labyrinth. Evidence of an infection of the secondary tympanic membrane similar to that shown in figure 9 is seen frequently, but it is rare in my experience to find a pyogenic destruction as shown in figure 10.

The first two illustrations (figs. 7 and 8) show no evidence of infection. In figure 9, however, there is a definite inflammatory process

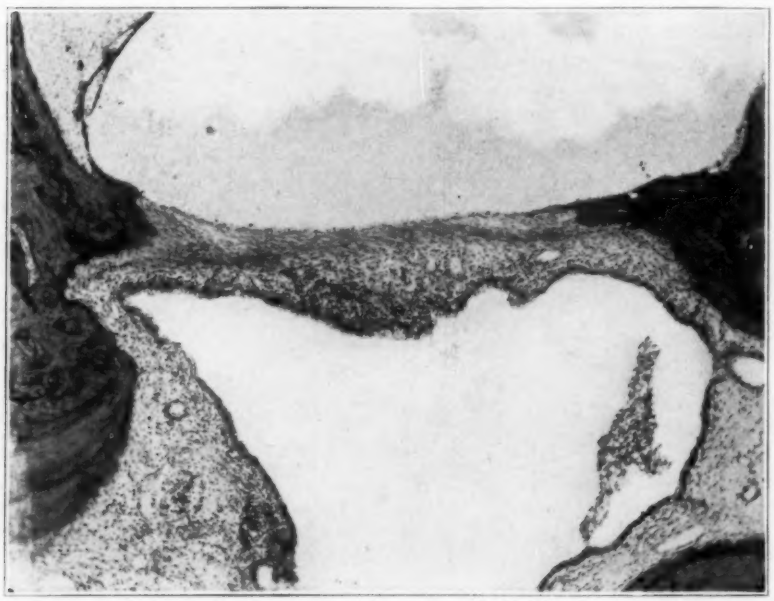

Fig. 9.—Early inflammatory changes of the secondary tympanic membrane. Infection is limited to the mucous membrane on the middle ear surface of the membrane. Figure 7 shows the membrane from the right, and figure 9 that from the left ear of a child aged 11 months that died of tuberculous meningitis.

which is limited to the middle ear and the external layer of the secondary tympanic membrane. This patient, aged 11 months, had, in addition to pyogenic otitis media, tuberculous meningitis and serous labyrinthitis on the left side. The coagulated serum seen in the scala tympani just above the round window membrane is evidence of a serous labyrinthitis. Since no histologic evidence of tuberculosis is seen in the middle or the inner ear, it might be inferred that the serous exudate in the labyrinth in figure 9 is due to the inflammatory process in the middle ear and the secondary tympanic membrane. Sections from other parts of the

cochlea of this case, however, show that the labyrinthitis is not limited to the basal coil and the cochlear aqueduct, but that another localized area of labyrinthitis is present in the apex of the cochlea (fig. 29).

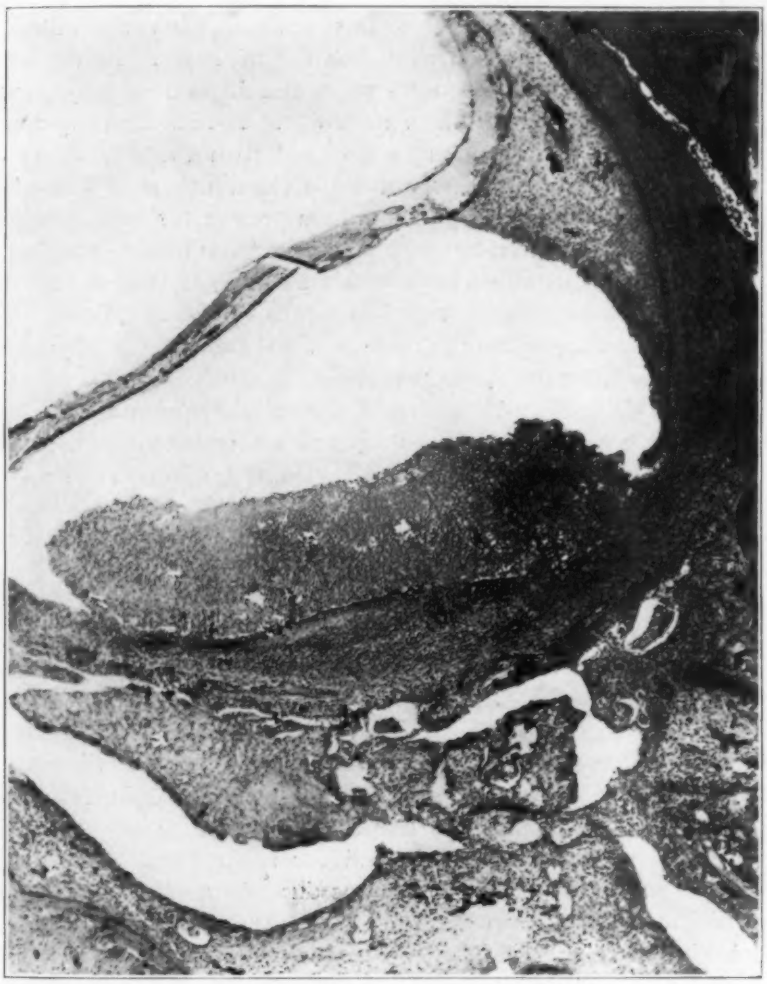

Fig. 10.—Marked cellular infiltration of the secondary tympanic membrane in a child aged 10 months that had pneumonia, acute suppurative otitis media, labyrinthitis and pneumococcus meningitis. Figure 3 shows infection of the stapedio-vestibular articulation in this patient.

The exudate in the labyrinth, therefore, is probably referable to the tuberculous meningitis rather than to the pyogenic infection in the middle ear.

There are in the laboratory two examples of an extensive pyogenic destruction of the secondary tympanic membrane. The one shown in figure 10 is from an infant, aged 10 months, with acute otitis media, purulent labyrinthitis and pneumococcus meningitis. In this case the clinical history and the microscopic sections suggest that the infection extended from the upper respiratory tract to the middle ear and through the round window to the labyrinth and the meninges. In the other patient, aged 9½ years, there were otitis media, purulent labyrinthitis and streptococcus meningitis (figs. 4 and 34). The secondary tympanic membrane in this case was more damaged than the one shown in figure 10, but the clinical history and the examinations of the spinal fluid indicated that the meningitis had been present for two weeks and the drums had been opened ten days before complete deafness and other symptoms of a suppurative labyrinthitis suddenly appeared. In this case, contrary to the one illustrated in figure 10, the labyrinthitis was probably an extension from the meninges, and the secondary tympanic membrane was destroyed from within the labyrinth.

Tuberculosis of the middle ear and caseous destruction of the round window, with a secondary labyrinthitis and tuberculous meningitis, are a relatively common occurrence. The secondary tympanic membrane is apparently more resistant to the extension of a pyogenic infection than it is to tuberculosis. Figure 11 shows caseation of the secondary tympanic membrane and the mucous membrane of the middle ear in a child, aged 3 years, who died of tuberculous meningitis.

Chronic inflammatory changes in the mucosa of the middle ear are identical in appearance with those in the mucous membrane lining the accessory nasal sinuses. Infiltration with round cells, plasma cells and eosinophils, together with polypoid degeneration and a tendency toward the formation of infected cysts, is common to both. This is illustrated in figure 12. This patient, aged 32, gave a history of discharging ears since infancy; bone conduction was much better than air conduction for a 512 double vibration fork, and for many years he had been "very hard of hearing." His death was due to a mediastinal sarcoma. This patient had neither labyrinthitis nor meningits, but his case is included in this paper to illustrate the reaction of the secondary tympanic membrane to a chronic infection of the middle ear. Other illustrations from this case are figures 5, 6 and 27.

FISSURA ANTE FENESTRAM

Fissura ante fenestram is well known to anatomists and embryologists. It was described by Siebenmann,[3] in 1890, and has recently

3. Siebenmann, Friedrich: Die Korrosionsanatomie des knöchernen Labyrinthes des menschlichen Ohren, Wiesbaden, J. F. Bergmann, 1890, table 8, fig. 14.

been described and modeled by Bast [4] of the University of Wisconsin. As the name implies, the fissura or irregular canal is located just anterior to the oval window. It is roughly a cone-shaped channel in the bony wall that separates the perilymphatic cistern from the middle ear. The appearance and location of the normal fissura in a man, aged 75, is illustrated in figure 13. This patient had no infection of either the middle or inner ear, but died as a result of myocarditis and a generalized arteriosclerosis. Above and to the left in figure 13 is seen a cross-

Fig. 11.—Tuberculous infection of the mucous membrane of the middle ear and caseous destruction of the secondary tympanic membrane. Miliary tuberculosis and tuberculous meningitis in a child aged 3 years.

section of the facial nerve in the fallopian canal, and below, a portion of the basal coil of the cochlea. The fissura contains fibrous tissue and a few blood vessels. It communicates freely with the perilymphatic space, but a connection with the middle ear mucosa is often difficult to demonstrate.

4. Bast, T. H.: The Ossification of the Labyrinthine Capsule, Tr. Am. Otol. Soc. **18**:78, 1928.

The next four illustrations (figs. 14, 15, 16 and 17) show the anatomic relation of this structure to the stapes and in addition an infection of the fissura in a child aged 6 weeks. This patient was admitted to the hospital in a moribund condition with a meningococcus meningitis, and died within twenty-four hours. The illness began one

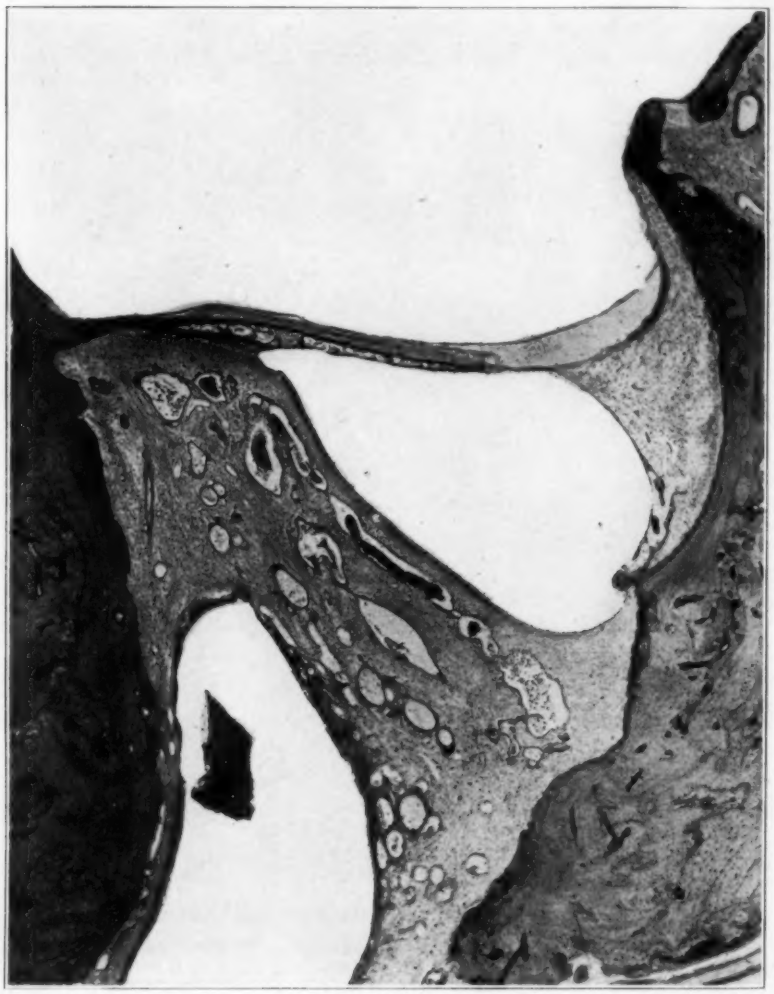

Fig. 12.—Thickening of the secondary tympanic membrane due to chronic suppurative otitis media. This infection was not associated with labyrinthitis or meningitis. Figures 5, 6 and 27 are from the same case.

week before admission, with a cold in the head and constipation. On admission there were constant convulsive twitching of the left arm, a divergent strabismus and a nystagmus of the right eye. The spinal

fluid contained 1315 cells per cubic millimeter and many gram-positive intracellular organisms. There was no clinical evidence of an otitis media. The drum was not protruding and had a normal light reflex. This fact, together with the microscopic demonstration of an approximately normal drum, only slight evidence of infection of the middle ear mucosa, and the presence of free pus in the labyrinth, in the fissura and in the middle ear, suggests that the sequence of events was a meningitis with a secondary labyrinthitis and extension to the middle ear by way of the fissura ante fenestram.

Fig. 13.—A normal fissura ante fenestram in a man aged 75. To the right is the perilymphatic cistern and the basal coil of the cochlea, and to the left the facial nerve and mucosa of the middle ear.

In figure 14 the most anterior part of the stapes joint is seen, and below and to the left the cochlear end of the aqueductus cochleae. Figure 15 is a little further anterior and shows the cartilage and a portion of the annular ligament at the anterior extremity of the oval window. To the right may be seen a part of the drum and a cross-section of the handle of the malleus. Figure 16 shows a cross-section of the basal coil of the cochlea and the fissura passing from the scala vestibuli toward the middle ear. The approximately normal appearance

of the drum and the collection of purulent discharge in the region of the middle ear end of the fissura can be seen. Figure 17 is the most anterior section of the series, cut vertically, that shows a portion of the fissura.

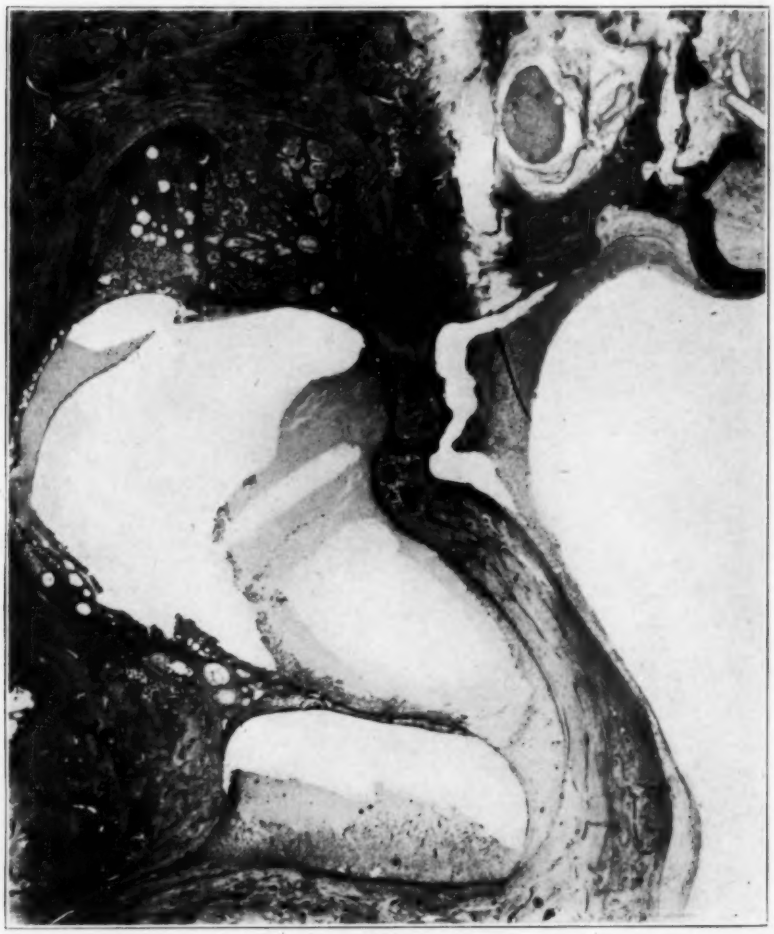

Fig. 14.—Meningococcus meningitis, labyrinthitis and otitis media in a child, aged 6 weeks. The first of a series of four illustrations to show an infected fissura ante fenestram and its relation to the stapes. This section is near the anterior end of the oval window. A purulent exudate in the middle ear, the perilymphatic cistern, the scala tympani of the basal coil and the cochlear end of the aqueductus cochleae may be seen.

This structure is present in adults as well as children and is possibly the portal of entry in the rare cases in adults who develop suppurative labyrinthitis within twenty-four or thirty-six hours after the first symptoms of an acute otitis media.

THE COCHLEAR AQUEDUCT

The cochlear aqueduct forms a direct communication between the subarachnoid space of the posterior cranial fossa and the scala tympani

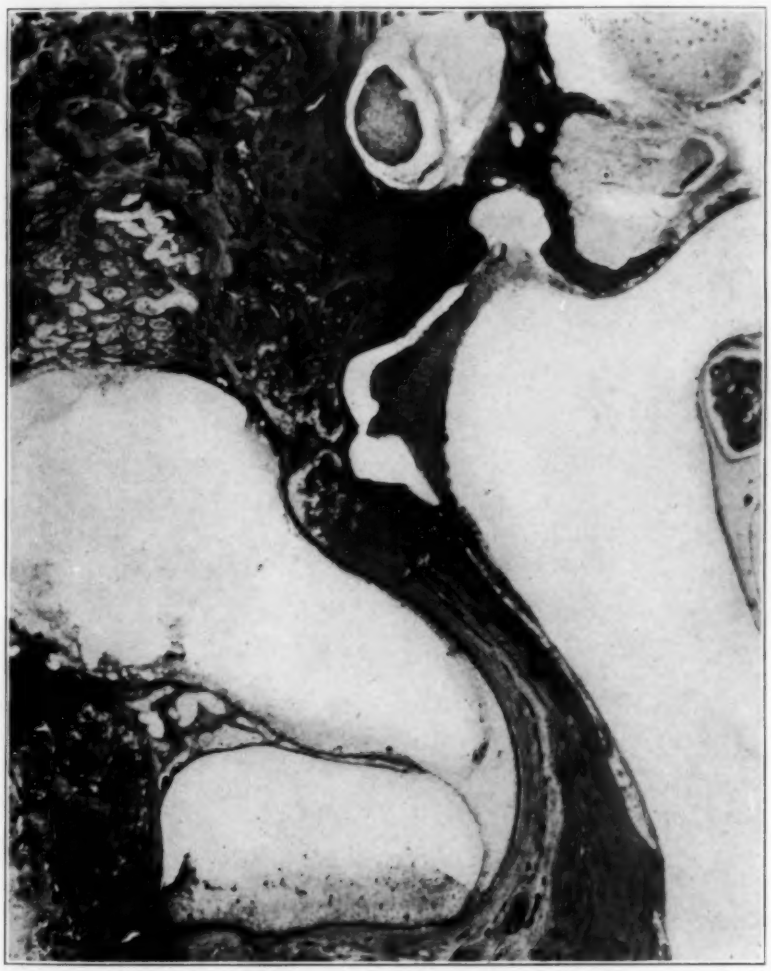

Fig. 15.—Cartilage at the anterior extremity of the oval window and a portion of the stapediovestibular ligament.

of the cochlea. Figure 18 shows a longitudinal section through the entire length of the cochlear aqueduct in a new-born child. The aqueduct opens into the cochlea just above the membrane of the round window. The cranial end is much larger than the labyrinthine end. A cross-section of a normal cochlear aqueduct in a child, aged 4 months, is shown in figure 19. It is lined throughout with dura, and the

lumen is filled with arachnoid tissue continuous with that covering the cerebellar lobes. Figure 20 illustrates the typical appearance of an infected cochlear aqueduct. The dural lining is intact but the arachnoid

Fig. 16.—This section is anterior to the oval window and shows an infected fissura acute fenestram. Figure 28 is a midmodiolar section of the cochlea from this case.

tissue is completely destroyed. This child, aged 9½ years, had streptococcus meningitis and labyrinthitis. The stapes in this case is shown in figure 4 and the cochlea in figure 34.

There is much discussion as to whether the lumen of the cochlear aqueduct is open or closed. The excellent article by W. E. Grove,[5] in 1929, on otologic observations in trauma of the head included a

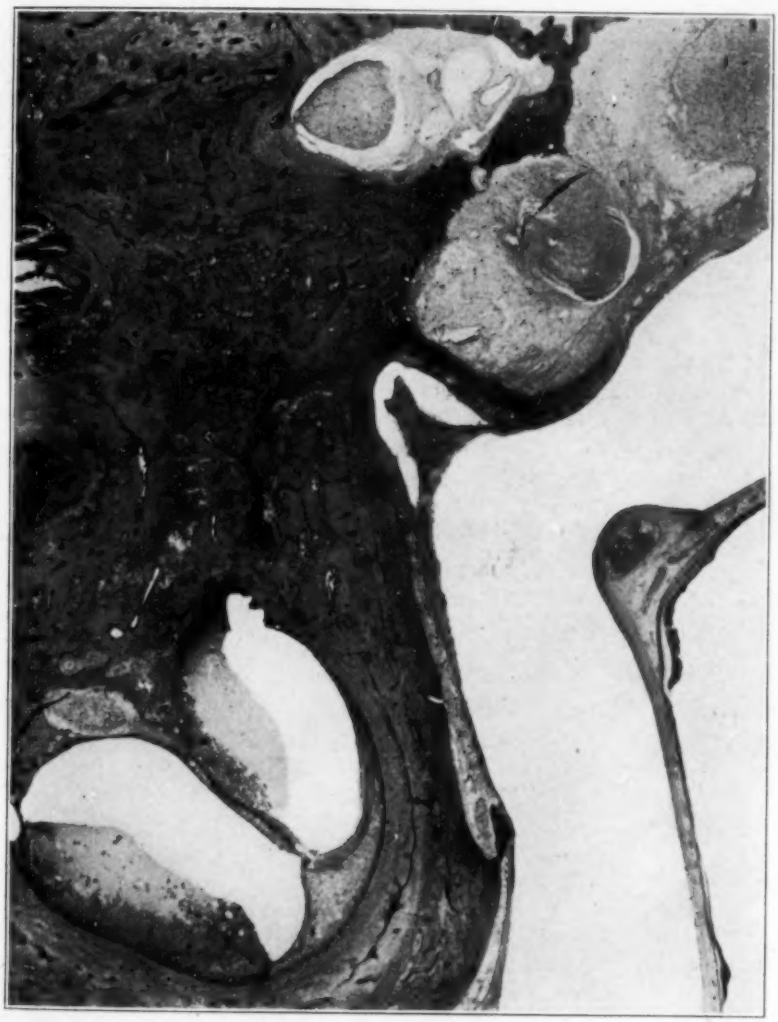

Fig. 17.—This is the most anterior section of a vertical series that shows the fissura (about 500 mm. anterior to the anterior margin of the oval window).

comprehensive review of the literature in regard to the histologic appearance of the cochlea in cranial injuries. Ulrich,[6] in 1926, reported

5. Grove, W. E.: Otologic Observations in Trauma of the Head, Arch. Otolaryng. **8**:249 (Sept.) 1928.

6. Ulrich, K.: Verletzungen des Gehörorgans bei Schädelbasisfracturen, Acta otol-laryng., suppl. **6**:1, 1926.

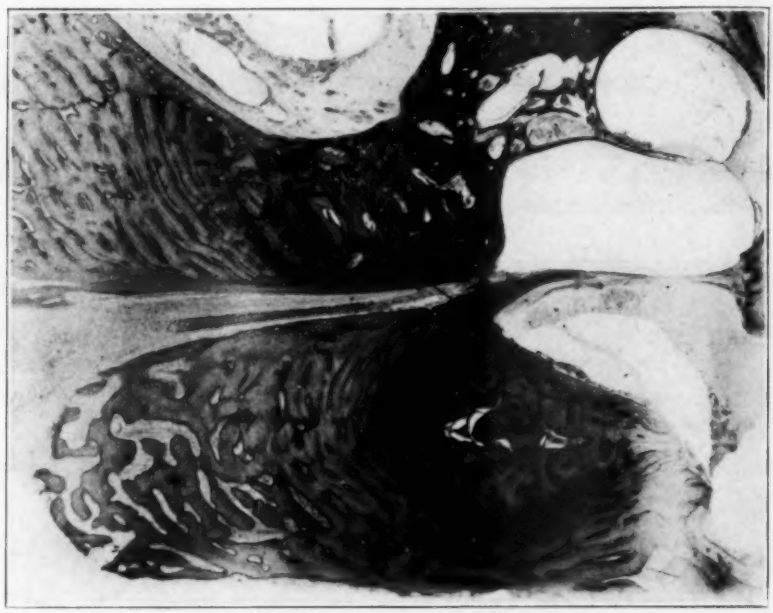

Fig. 18.—A longitudinal section of the cochlear aqueduct in a new-born child. It forms a direct communication between the subarachnoid space of the posterior cranial fossa and the scala tympani of the cochlea.

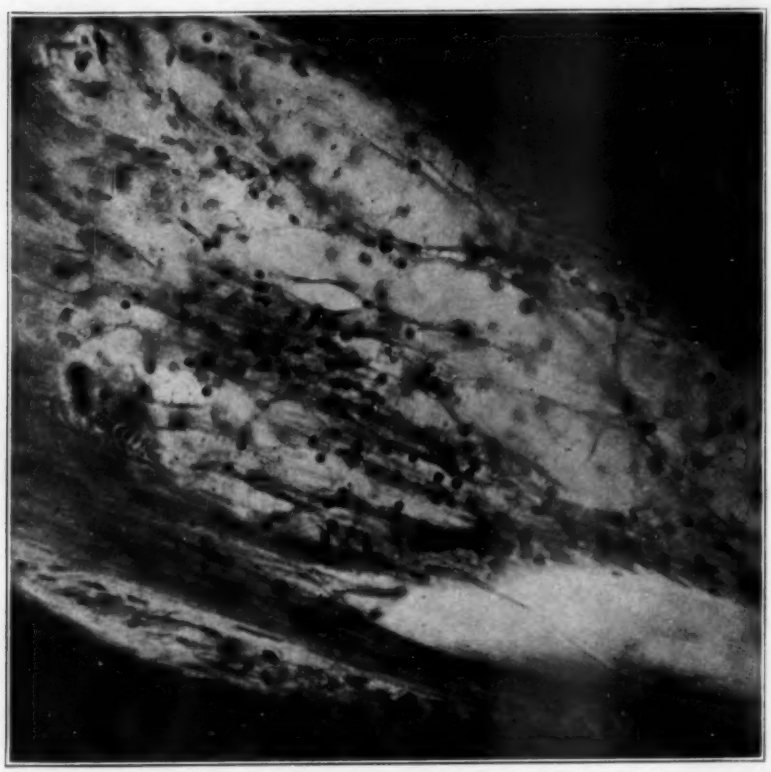

Fig. 19.—High power view of a cross-section of a normal cochlear aqueduct, showing the bony canal lined with dura and filled with arachnoidal reticulum.

the microscopic changes seen in the study of temporal bones from patients who died after a fracture of the base of the skull. He found blood in the cochlea in every case. The blood was always in the perilymph spaces, never in the endolymph, and was most abundant in the scala tympani of the basal coil. He illustrated, in figures 3 and 4 in his article, the presence of blood in the scala tympani of the basal coil and in the cochlear aqueduct, and concluded that this proved that the aqueduct is patent in man. Voss,[7] in 1926, published an excellent article on birth trauma and damage to the temporal bones, in which he reported the histologic study of thirty temporal bones of infants who

Fig. 20.—A cross-section of the cochlear aqueduct in a patient with streptococcus meningitis and labyrinthitis. Complete destruction of the arachnoidal tissue in the lumen is seen. Figure 34 shows the appearance of the cochlea in this case.

died soon after birth, presumably from pressure. He found blood in the scala tympani of the basal coil in every case.

After referring to the pathologic changes reported by Alexander, Theodore and Manasse in the inner ear of the patients who died several months or years after a severe head injury, Grove concluded from his study of the literature that after a head injury the lesions of the inner ear in human beings are a regular sequence of events. First, there is hemorrhage in the perilymph spaces, the site of predilection being the

7. Voss, O.: Klinische und pathologisch-anatomische Folgeerscheinungen gebürtstraumatischer Schädigungen des Felsenbeines, Monatschr. f. Kinderh. **34**:568, 1926.

vicinity of the round window. Second, the blood is in time partly absorbed and partly organized, leading to atrophy of the finer nerve branches and to degeneration of the neuro-epithelium of both cochlea and vestibule. These changes are always more marked in the basal coil of the cochlea. The significant fact in the reports of head injuries in human beings is that the pathologic changes described are almost always symmetrical, and that the greatest collection of blood is near

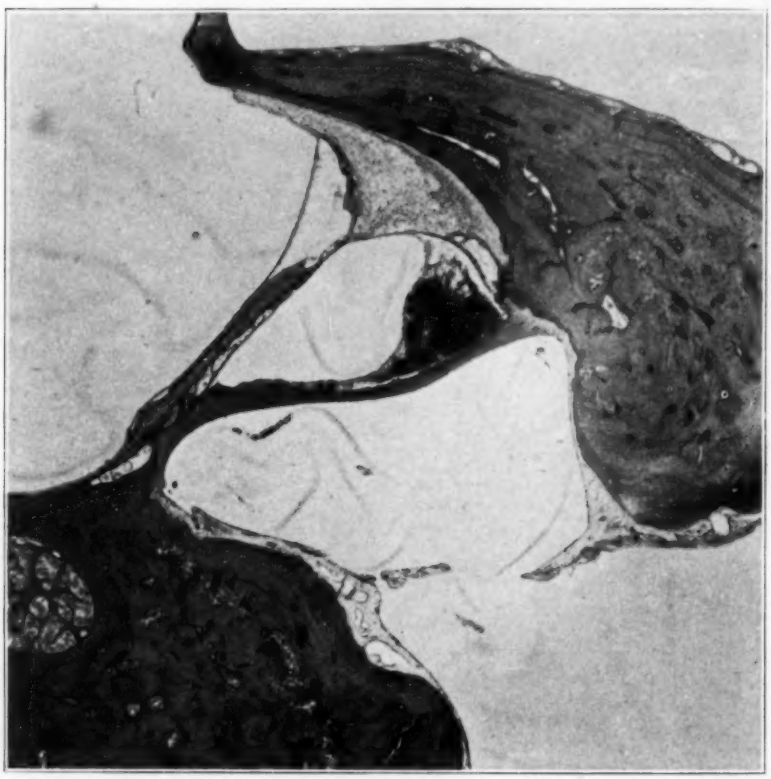

Fig. 21.—A clump of red blood corpuscles in the scala tympani, thirty-two hours after an intracranial operation. This is a frequent observation after intracranial operation or injury. It proves that the cochlear aqueduct is patent in man and suggests that there is a normal flow of cerebrospinal fluid from the meninges to the cochlea by way of the aqueductus cochleae.

the cochlear end of the aqueduct. Furthermore, it is rare to find a fracture in the bone in this region or a tear in the round window membrane. Brunner,[8] in 1925, published an extensive clinical and experi-

8. Brunner, Hans: Pathologie und Klinik der Erkrankungen des Innenohres nach stumpfen Schädeltraumen, Monatschr. f. Ohrenh. **59**:697, 763 and 922, 1925.

mental study of inner ear lesions due to trauma to the skull. He found free red blood cells and exudate in the aqueductus cochleae and in the scala tympani of the basal coil, but concluded that the blood must have originated from slight lesions in the perilymphatic space. He described in some detail the clinical symptoms and the pathology of a condition he called "commotio auris interna."

Free red blood cells in the meshes of the arachnoid tissue lining the cochlear aqueduct and in the lower end of the scala tympani are present in many of the sections of temporal bones from patients who succumbed soon after an intracranial operation for tumor of the brain. The typical appearance of the collection of blood in the scala tympani in such a case is illustrated in figure 21. The illness of this patient, aged 31, began with severe headache; six months later she entered the hospital with an extreme degree of choked disk, dizziness, nausea, vomiting, numbness in the left arm and leg and weakness of the right side of the face. An audiometer test with the 1A Western Electric Audiometer, four days before operation, showed a normal curve with exceptionally acute hearing for the high tones. Bone conduction was normal for 512 on both sides, and the Weber test was normal. The patient died thirty-two hours after an exploratory operation for a cerebellar tumor. The temporal bones were removed at autopsy less than three hours after death. Histologic examination showed blood in the cochlear aqueduct and in the scala tympani of the basal coil on both sides. This observation, together with many others in similar cases, seems to furnish convincing evidence that there is a normal flow of cerebrospinal fluid in the cochlear aqueduct from the meninges to the scala tympani. That the blood did not gravitate into the cochlea after death or during the manipulations at autopsy is proved by the fact that during the past five years section of approximately 1,000 pairs of temporal bones has not revealed red blood cells in this location unless there was infection, leukemia or an operative or traumatic injury to the skull that caused bleeding into the subarachnoid spaces.

The observation of Bagley [9] that from 0.5 to 5 cc. of blood drawn from the vein of a dog and slowly injected anywhere under the meninges of the same animal will always produce a local meningeal reaction or sterile meningitis is of interest in this connection. Figure 22, reproduced from the *Archives of Surgery*, shows the meningeal reaction on the seventeenth day after the injection of blood into the cisterna magna of a dog. It is possible that the late changes described by Alexander, Theodore and Manasse in patients who recovered from a head injury

9. Bagley, C.: The Grouping and Treatment of Acute Cerebral Traumas, Arch. Surg. **18**:1078 (April) 1929.

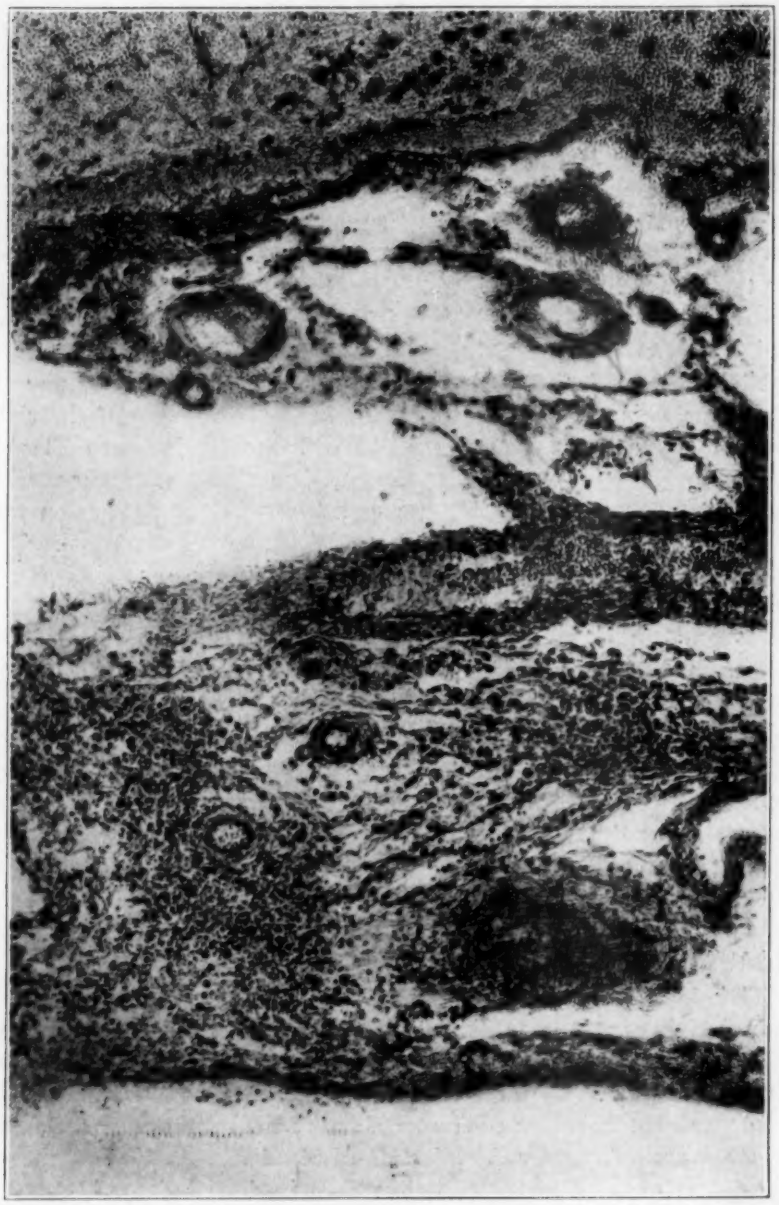

Fig. 22.—Thickening and cellular infiltration of the meninges in a dog on the seventeenth day after the subdural injection of a few cubic centimeters of blood drawn from the jugular vein of the same animal (Bagley, Arch. Surg. **18**:1078 [April] 1929).

are due to the irritating effect of the clot in the scala tympani and the secondary damage to the neuro-epithelium rather than to any local injury at the time of the fracture.

If there is a normal flow of cerebrospinal fluid to the cochlea by way of the aqueductus cochleae, and the lumen is large enough to allow the passage of red blood cells, it is truly remarkable that a labyrinthitis does not complicate every meningeal infection. The arachnoid tissue that fills the lumen of the aqueduct affords the only protection to a spread of the infection by this route. There has been much speculation

Fig. 23.—Accumulation of red blood cells at the base of the cochlea, thirty-two hours after an intracranial operation. In this case no blood cells are seen in the spiral ganglion, as in figure 25.

about the signs and symptoms of an obstruction of the cochlear aqueduct, but there is still much to learn about the circulation of the labyrinthine fluids.

THE CRIBRIFORM AREA

The histologic study of temporal bones from patients who died soon after an intracranial operation also shows that red blood cells in the cerebrospinal fluid may find their way (1) along the sheath of the facial nerve as far as the geniculate ganglion, (2) along the various branches

Fig. 24.—Collection of red blood cells at the base of the cochlea in an infant that died of birth hemorrhage.

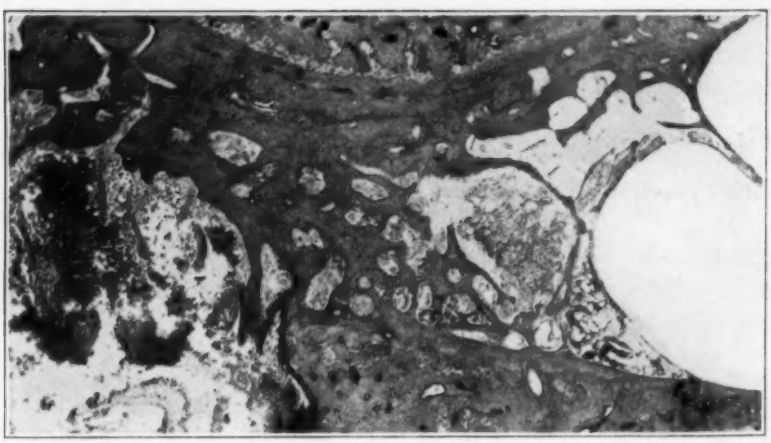

Fig. 25.—Showing the accumulation of red blood cells at the base of the modiolus, around the fibers of the cochlear nerve and between the ganglion cells of the basal coil. This patient died forty hours after an intracranial operation for tumor of the brain.

of the vestibular nerve as far as their end-organ, (3) along the course of the auditory nerve, at least as far as the spiral ganglion of the basal coil, and finally (4) along the course of the blood vessels into the cochlea. These four routes, together with the cochlear aqueduct, constitute the pathways by which a meningeal infection may extend to the labyrinth.

The following pictures illustrate the various points mentioned. Figure 27 is a normal midmodiolar section from a man, aged 32, that shows the cochlea and internal auditory canal free from infection or

Fig. 26.—High power view of the ganglion cells shown in figure 26. Red blood cells around the fibers of the cochlear nerve and ganglion cells are visible.

hemorrhage. Figure 23 is from a patient, aged 31, who died thirty-two hours after an exploratory cerebellar operation. In this midmodiolar section no trace of blood is seen inside the cochlea; in other sections of the same cochlea, however, a large accumulation of red blood cells is found in the basal coil around the cochlear end of the ductus perilymphaticus (fig. 21). Blood clots are seen in figure 23 at the base of the modiolus. A similar condition has been found in every patient who died within a few days after an intracranial operation or injury and in infants with hemorrhage at birth (fig. 24). Figures 25 and 26 illustrate in more detail the collection of blood cells (1) at the base of

the cochlea, (2) along the course of the auditory nerve, (3) in the spiral ganglion and (4) in the perivascular spaces. On Feb. 1, 1926, this patient, aged 38, had an exploratory craniotomy for a pineal tumor. He died on February 3 at 9:15 a. m. and the temporal bones were removed on the same day at 12 noon. At the conclusion of the operation the dura was not closed, the galea aponeurotica was not approximated and the bone flap was removed for maximum decompression. There

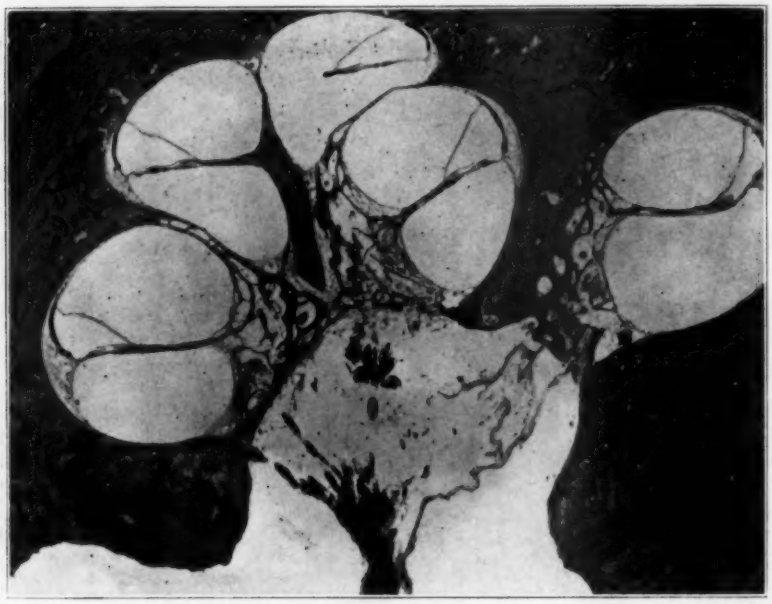

Fig. 27.—A midmodiolar section of the cochlea from a man, aged 32. Death was due to a mediastinal sarcoma. There is no evidence of a pyogenic infection. Compare with similar sections of the cochlea from cases of meningitis (Although it is not pertinent to the subject of this paper, attention should be called to the pathologic changes in the cochlea in this case. In addition to the sarcoma there is a history of syphilis for six years. The Wassermann reaction was postive. Although no audiometer or careful tuning fork test was made, the history states that this patient was "very hard of hearing." Bone conduction was better than air conduction; there was a dry perforation of the right drum inferiorly, and a history of discharge at intervals since childhood. The evident pathologic lesions in the cochlea are: (1) a shrunken deformed Corti's organ in the apex, an approximately normal condition in the middle coil and complete atrophy in the lower portion of basal coil; (2) an adherent tectorial membrane in the apical and upper half of the middle coil, a normal membrane in the lower middle coil and adherence in the basal coil; (3) atrophic changes in the ganglion cells, nerve fibers in the osseous spiral lamina and atrophy of the organ of Corti in the basal turn, and (4) thickening of the walls of the internal auditory artery.)

Fig. 28.—Meningococcic meningitis and labyrinthitis in a child aged 6 weeks. Figures 14, 15, 16 and 17 are from the same case.

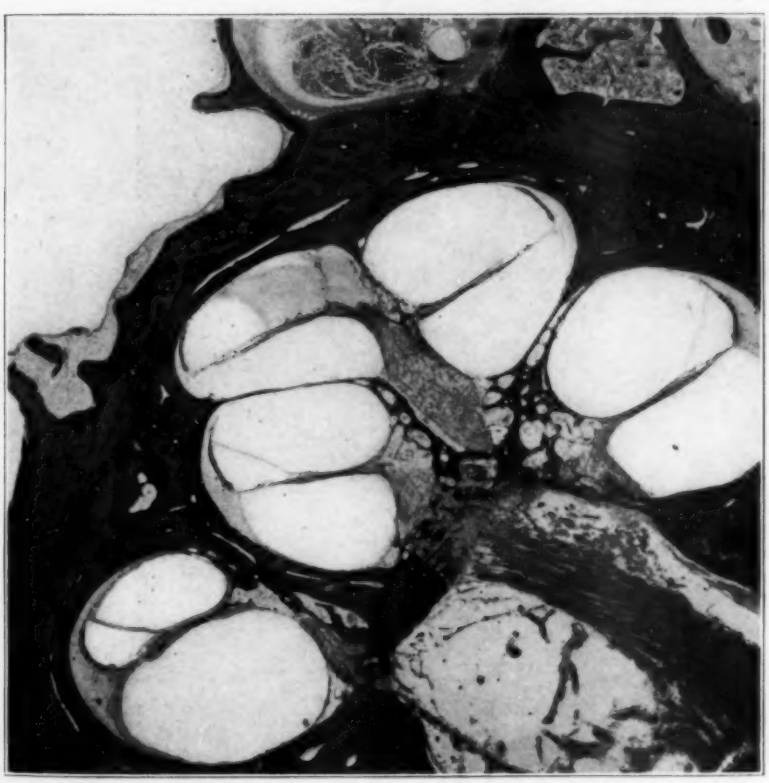

Fig. 29.—Tuberculous meningitis in a child, aged 11 months, with a localized serous labyrinthitis in the apical and basal coil. Cellular exudate may be seen in the cochlear nerve. Figures 7, 9 and 31 are from the same case.

Fig. 30.—Purulent meningitis without involvement of the labyrinth in a child, aged 8 years. The meningitis was secondary to an acute coryza. The organism was micrococcus catarrhalis and tetragenus.

Fig. 31.—Tuberculous meningitis and serous labyrinthitis. Perivascular infiltration and osteoid tissue at the cribriform area may be observed.

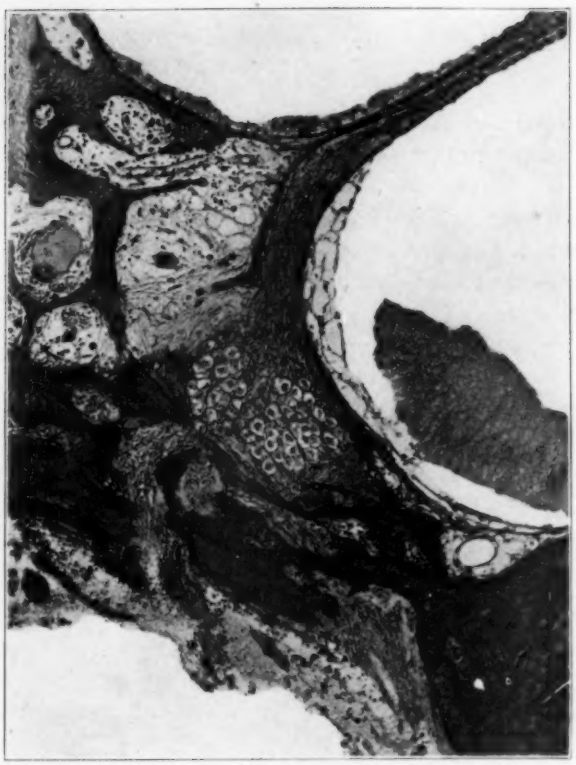

Fig. 32.—Meningitis and labyrinthitis in a woman, aged 53, who had diabetic gangrene of the right foot. Changes around the modiolar blood vessels may be seen.

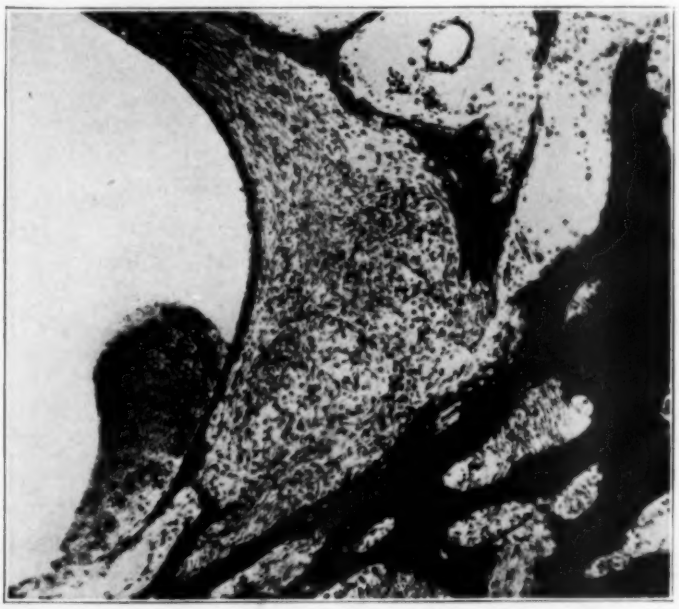

Fig. 33.—Extension of a meningeal infection to the cochlea ganglion and labyrinth in a patient aged 5 months. The organism was Pneumococcus type II.

was no postoperative increase of intracranial pressure in this case that could account for the presence of the blood in the cochlea and spiral ganglion.

The eight figures, 28 to 35, illustrate the appearance of the cochlea and the internal auditory canal in several types of meningitis. It is usually impossible to determine the exact route by which a meningeal infection has extended to the labyrinth, but the observations mentioned on the labyrinthine distribution of red blood cells after an intracranial

Fig. 34.—Destruction of the nerve, ganglion cells and all membranous structures in the labyrinth. In this case the meningitis was primary and the labyrinthitis secondary. The stapes is illustrated in figure 4 and the cochlear aqueduct in figure 20.

operation suggests the various pathways of infection. Figure 28 shows free pus in the scalae of the cochlea and destruction of the auditory nerve and spiral ganglion in a child, aged 6 weeks, with meningococcic meningitis and labyrinthitis. Figure 29 is a midmodiolar section of the cochlea from a child, aged 11 months, with tuberculous meningitis and

a serous labyrinthitis. The serous exudate in the cochlea is localized in the apex and basal coil. Figure 30 illustrates the pyogenic infiltration of the auditory nerve in a child, aged 8 years, with a purulent meningitis, but without involvement of the cochlea, the spiral ganglions or the

Fig. 35.—Pneumococcus meningitis and secondary labyrinthitis in a child aged 4 months. There is marked edema of the modiolar tissues.

perivascular spaces. Figure 31 shows cellular infiltration of the nerve in the internal auditory canal with an extension to the ganglion cells and a serous exudate in the scala tympani of the basal coil. This child, aged 11 months, died of tuberculous meningitis. Purulent meningitis

and serous labyrinthitis, with some edema of the modiolar tissues and perivascular infiltration are illustrated in figure 32. This patient, aged 53, succumbed within a few days after an amputation for diabetic gangrene of the leg. The meningeal infection was only recognized at autopsy. The cellular infiltration of the spiral ganglion in figure 33 probably represents the extension of the meningeal infection along the nerve. There is pus in the scala tympani but very little infiltration of the perivascular spaces. This child, aged 5 months, was admitted to the hospital in a moribund condition and died in less than two hours. It is interesting to note that the temperature was 98.4 F., the eyes, ears and throat were normal and no stiffness of the neck and no Kernig sign were elicited, but the cerebrospinal fluid contained 2,400 cells per cubic millimeter and many organisms that proved to be pneumococcus type II. In figure 34 an extreme degree of destruction of the nerve, ganglion cells and membranous labyrinth is shown as a typical example of a streptococcus meningitis. Other illustrations from the same case are figures 4 and 20. Another case of pneumococcus meningitis in a child, aged 4 months, is shown in figure 35. The marked edema of the tissues around the ganglion and the modiolar blood vessels is a striking contrast to the purulent infiltration in figure 34. Both of these patients, however, had purulent meningitis for about two weeks before death.

It is difficult to draw any conclusions of clinical importance from these illustrations, but they give one a clearer and more comprehensive understanding of the anatomy, the physiology of the labyrinthine fluids and the more common pathologic lesions of the inner ear.

EXPERIMENTAL STUDIES IN PEANUT BRONCHITIS*

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The clinical manifestations and pathologic changes produced by the aspiration of peanut kernels into the air passages have been the subject of many reports during the past decade. Patterson [1] and Jackson and Spencer [2] were among the first to call attention to the unusual type of bronchitis produced; the latter, at the suggestion of Rosenbloom, introduced the descriptive term, arachidic bronchitis (*Arachis hypogaea* is the botanical name for peanut), by which it is commonly known. There has been considerable speculation concerning the etiologic factors responsible for this reaction, which is so strikingly different from that produced by other types of foreign body, but no definite experimental work has appeared.

Within the past eighteen months, we have observed at the Strong Memorial Hospital six patients, three of whom died in spite of successful bronchoscopic removal of the peanut. We have therefore undertaken to study the cause, not merely as an interesting problem in etiology but also with the hope that from it might come some suggestion for specific therapeutic measures.

CLINICAL CONSIDERATIONS

It is important to realize that in this country where the peanut is a common article of diet, accidental aspiration is not unusual. Many patients are lost when a suggestive history of choking and coughing has been ignored or discounted because of the brief symptomless period which not infrequently follows the accident. The striking feature of foreign bodies of vegetable origin is the rapidity with which acute inflammatory changes are produced. This is especially true of the peanut. Within a few hours, the child may be in danger of death. The rapidity and degree of inflammatory reaction vary indirectly with the age—the younger the child the more violent the reaction. The mortality is highest in children under 2 years. In older children, the reaction is

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1. Patterson, E. J.: New York M. J. **109**:101 (Jan. 18) 1919.

2. Jackson, G., and Spencer, W. H.: Arachidic Bronchitis, J. A. M. A. **73**: 672 (Aug. 30) 1919.

much less acute and more in accordance with that caused by other foreign bodies. The clinical picture is that of rapidly increasing toxemia and asphyxia. Cyanosis is usually present and later that intense pallor, so misleading to the uninitiated, which results from a failing myocardium. Cough is a distressing feature. It is frequently paroxysmal and may be productive of tenacious, purulent sputum. The "asthmatoid wheeze," heard during forced expiration, is another fairly constant sign. The pulse and respiration rates are greatly increased. Fever is always present in these young children and is of the irregular, septic type. The physical signs are those of a severe generalized bronchitis, most marked about the area of the invaded lung. Diminished expansion of the affected side is regularly observed. The voice is rarely lost, a point which may be helpful in distinguishing this condition from laryngeal diphtheria, which it often closely simulates. The restlessness, cough, obstructive dyspnea and rapid prostration constitute a picture not easily forgotten. The necessity of prompt bronchoscopic removal cannot be emphasized too strongly. All our fatalities have been in infants who were admitted many hours after the accident and in whom the removal of the peanut had no appreciable effect on the rapidly advancing asyphyxia. The possibility of spontaneous expulsion is slight, for the kernel, owing to its small size, is rapidly drawn deeply into the lung and firmly anchored by the resulting edema.

PATHOLOGY

The effects produced by peanuts aspirated into the lungs have been thoroughly studied endoscopically and frequently described. During the early stage, there is seen intense hyperemia and rapidly developing edema about the site of lodgment. Somewhat later, depending on the age of the child, thick, tenacious pus is formed. The entire bronchial tree is rapidly involved. We have seen several fatal cases in which the changes in the opposite lung were nearly as marked as those in the invaded one. The amount of purulent secretion is often enormous, and its character is so tenacious that in some cases a true cast of the bronchial tree is produced. We have been impressed by the relatively small size of the kernel necessary to produce a violent or fatal reaction. In older children, of course, the reaction is far less severe and is more in accordance with the changes expected from foreign bodies of other origin—the formation of abscesses in the portion of the lung distal to the invaded bronchus.

At autopsy, the surface of the lung is seen to be mottled with deep red areas of atelectasis, interspersed with areas of emphysema, often appearing as blebs. The lymph nodes at the hilus and at the bifurcation are enlarged; many appear red and softened. On section, the most striking feature is a purulent exudate filling the entire bronchial tree.

This, we emphasize, is present in both lungs. The peanut, if still present, is seen entirely to fill the lumen of the bronchus, the mucosa of which is greatly swollen.

Microscopic Observations.—The mucous membrane of the trachea and the bronchi is often desquamated; the epithelial cells in other areas appear fairly normal (fig. 1). The submucosa is intensely edematous;

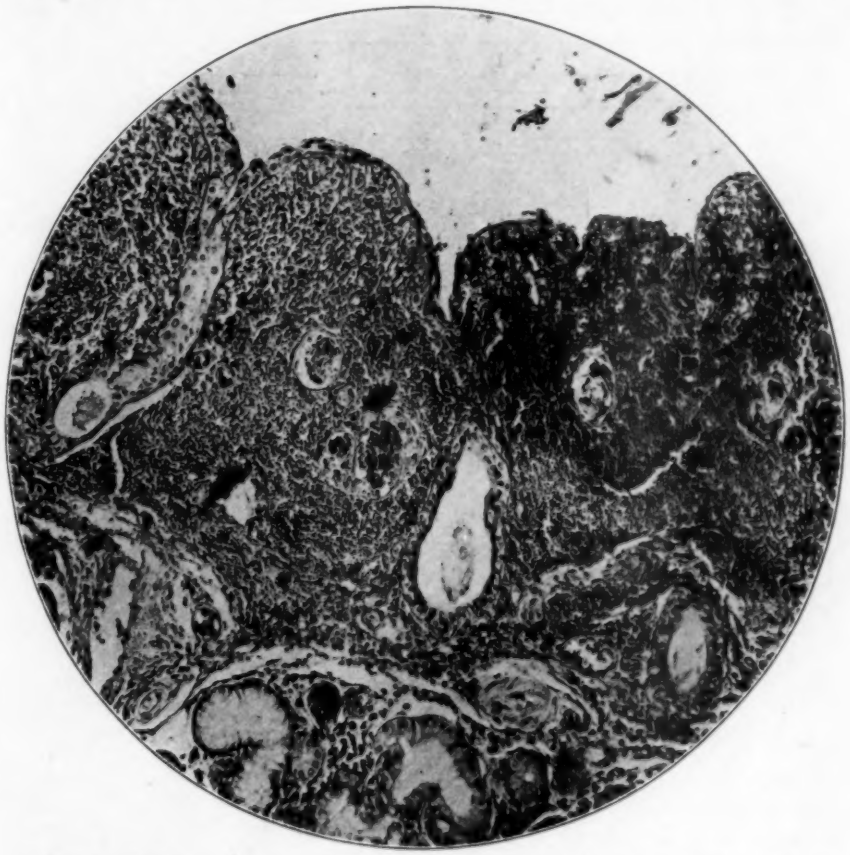

Fig. 1.—Section of the trachea of an infant, aged 15 months, who died of arachidic bronchitis. The desquamation of the surface epithelium, the marked round cell infiltration and the engorged blood vessels are apparent. The mucous glands are essentially unchanged.

vessels are greatly engorged and there is invasion by numerous cells. These are chiefly mononuclear. Occasionally giant cells are seen. The mucous glands are usually essentially unchanged.

The most striking feature of the microscopic picture in the parenchyma of the lung (fig. 2) is the enormous thickening of the alveolar septums due to edema and infiltration with round cells. The number

of polymorphonuclear cells is often surprisingly small. The vessels are greatly dilated. The alveoli often contain a purulent exudate similar to that seen in the bronchi. Areas of atelectasis and of emphysema are regularly observed.

Numerous hypotheses have been offered to explain the unusually irritating effects of the peanut on the lower respiratory tract. Jackson

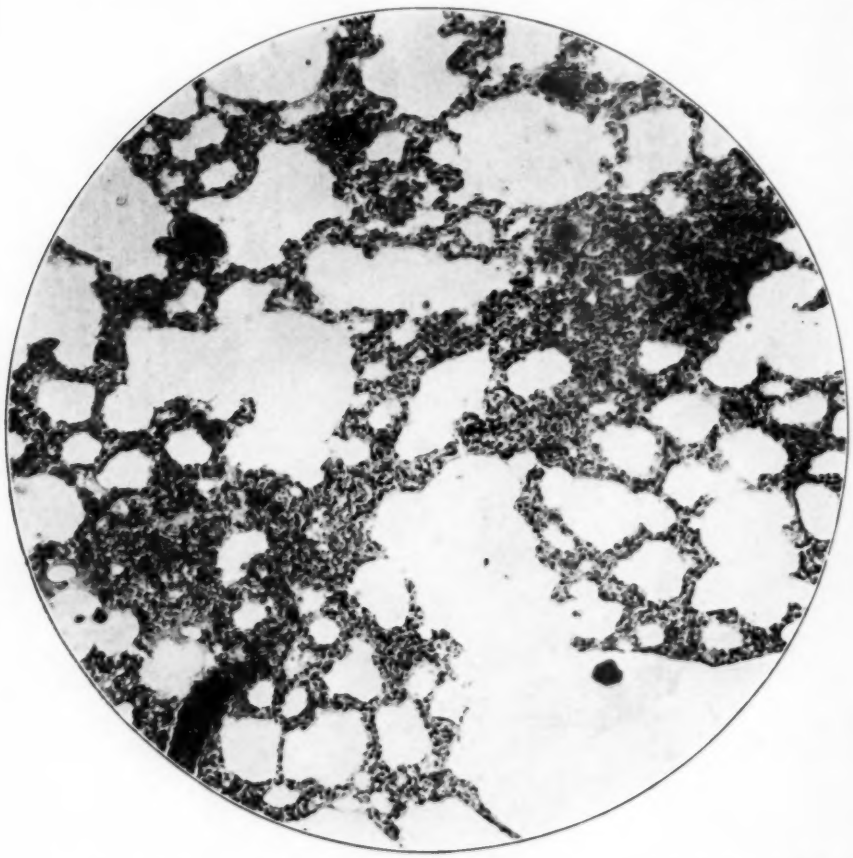

Fig. 2.—Lung tissue from an infant, aged 15 months, showing changes typical of arachidic bronchitis: areas of atelectasis and emphysema, marked cellular infiltration of the alveolar septums and engorgement of blood vessels.

and Spencer [2] have suggested the reaction resulting from the "presence of an alien protein parenterally introduced," as well as the possibilities for "rapid proliferation and activity of bacteria introduced and protected by the porous vegetable body." The action of "irritating chemical substances present in the peanuts, either naturally . . . or developed in the process of roasting" has also been considered. It occurred to

us that the effects of the chemical constituents of the peanut had not been carefully studied and we determined to make that the first part of an investigation.

CHEMISTRY

According to Lewkowitsch,[3] the Spanish peanut contains about 50 per cent oil, and the Virginia peanut about 42 per cent. As our experiments indicate that the extracted residue does not produce an inflammatory reaction typical of arachidic bronchitis, but that this reaction is produced by certain of the fatty acids present in the oil, we quote in the accompanying table the typical analysis of the acids given by Jamieson, Baughman and Brauns.[4]

These authors found no hypogeic acid ($C_{16}H_{30}O_2$) and no behenic acid ($C_{22}H_{44}O_2$), and they raised valid objections to the work of such

The Typical Analysis of the Acids in the Peanut Given by Jamieson, Baughman and Brauns

		Spanish Peanuts Grown in South Carolina, per Cent	Virginia Peanuts Grown in Virginia, per Cent
Liquid Unsaturated Acids:			
Oleic	$C_{18}H_{34}O_2$	52.9	60.6
Linolic	$C_{18}H_{32}O_2$	24.7	21.6
Solid Saturated Acids:			
Palmitic	$C_{16}H_{32}O_2$	8.2	6.3
Stearic	$C_{18}H_{36}O_2$	6.2	4.9
Arachidic	$C_{20}H_{40}O_2$	4.0	3.3
Lignoceric	$C_{24}H_{48}O_2$	3.1	2.6
Unsaponifiable matter		0.2	0.3
		99.3	99.6

authors as Heiduschka and Felser[5] who claimed that these acids are present.

PREPARATION OF MATERIALS

First Method.—Roasted peanuts bought in the open market were cleansed of their red skin, ground in a mortar, and extracted with hot alcohol in the apparatus described by Sperry.[6] After four or five hours, the extraction was interrupted, the peanut meal was dried, and ground fine enough to pass through a 20 mesh sieve. Eight hours' further extraction removed practically all traces of fatty material, as determined by extracting the residue with ether. The alcohol was removed by evaporation from the extract. The oil was taken up in ether and dried; then the ether was removed from it by evaporation under diminished

3. Lewkowitsch, J.: Chemical Technology and Analysis of Oils, Fats and Waxes, ed. 5, London, The Macmillan Company, 1913, vol. 2, p. 305.

4. Jamieson, Baughman and Brauns: Composition of Peanut Oil, J. Am. Chem. Soc. **43**:1372, 1921.

5. Heiduschka and Felser: Fatty Acids of Peanut Oil, Ztschr. f. Untersuch. d. Nahrungs- u. Genussmittel **38**:241, 1919.

6. Sperry, W. M.: Lipid Excretion, J. Biol. Chem. **63**:357, 1926.

pressure. The alcohol extraction removes from peanuts a large amount of sweetish, gummy material that is partly soluble in water. Of the three fractions, only the oil was found to be active in the production of typical lesions in the rabbit. As it was thought that perhaps the prolonged treatment with hot alcohol might have inactivated some constituent of the peanut, a second method of fractionation was tried.

Second Method.—Raw peanuts, 134 Gm., from which the skins were not removed were ground as fine as possible in a mortar and shaken at intervals for three hours with twice their weight of ether; they were then filtered on a Buchner funnel, dried, ground and passed through a 20 mesh sieve. Three more extractions were carried out; the fourth extract weighed only 0.2 Gm. The combined extracts were freed of ether. The oil was much paler than the oil extracted by the first method. No gum was extracted by the second method. The residue formed a paste with water or salt solution, whereas the residue in the first method formed a suspension. The paste was without effect when injected into the trachea of rabbits, whereas the oil was very effective.

Saponification of Oil.—This was carried out by boiling with alcoholic potassium hydroxide. In one experiment, 19.7 Gm. of mixed fatty acids and 0.0197 Gm. of unsaponifiable material were obtained. The unsaponifiable material was not tested because the free fatty acids appeared to have an intense activity.

Separation of Liquid from Solid Fatty Acids (Twitchell[7]).—Fifty-six grams of mixed fatty acids dissolved in 300 cc. of 95 per cent alcohol was treated with 12 Gm. of lead acetate in 300 cc. of boiling alcohol. After twelve hours, the white crystals were washed with cold alcohol, then recrystallized from boiling alcohol. The washings and the second mother liquor were discarded. Lead was removed from the salts of the solid fatty acids by shaking with ether and dilute nitric acid in a separatory funnel, the ethereal solution being washed with water until no lead could be detected in the washings. The ethereal solution was then dried and evaporated to constant weight on the water-bath; a hard white cake of solid acids was thus obtained. The soaps of these acids, even as dilute as 5 per cent, were solid and proved unsuitable for injection. It was found possible, however, to make a 10 per cent solution of the acids in commercial liquid petrolatum, warmed to 40 C.

The liquid fatty acids were obtained from the original mother liquor from which the solid lead salts had crystallized. Their soaps are liquid and produce a severe reaction in the trachea of the rabbit.

Separation of the Liquid Fatty Acids (Sperry and Bloor[8]).—Ten grams of liquid fatty acids dissolved in alcohol was treated with sufficient alcoholic sodium hydroxide to make the reaction just alkaline to phenolphthalein, and diluted with 200 cc. of water. Six per cent barium chloride was added until the precipitate suddenly coagulated. The solid barium salts were filtered, washed free of chloride and dried in air between filter papers. The dry soaps were refluxed with 70 cc. benzene containing 5 per cent alcohol until all but a small residue had dissolved. The hot solution was completely decanted from this gelatinous residue. The solid barium salts which crystallized after fifteen hours at 4 C. were filtered and

7. Twitchell, E.: Precipitation of Solid Fatty Acids with Lead Acetate in Alcoholic Solution, J. Indus. & Engin. Chem. **13**:806, 1921.

8. Sperry, W., and Bloor, W. R.: Fat Excretion: Method for Separation of Liquid Fatty Acids, J. Biol. Chem. **60**:269, 1924.

washed. The acids were liberated from these with hydrochloric acid and taken up in ether; the ether was dried and evaporated in a flask. This "oleic fraction" weighed 4.15 Gm. From the mother liquor was obtained a "linolic fraction" weighing 3.3 Gm. As is shown in the protocols of the experiments with rabbits, both fractions of the liquid acids are active, whereas the solution of the solid acids in liquid petrolatum is inactive when introduced into the trachea of the rabbit. Determinations of the iodine number indicate that these fractions are not pure, and suggest the presence of an acid more highly unsaturated than linolic. Consequently, the activity cannot at present be attributed to any particular unsaturated acid.

Preparation of Neutral Peanut Oil.—Four samples of peanut oil, each weighing about 10 Gm. were dissolved in alcohol and titrated with alcoholic sodium hydroxide; the values for free acid, calculated as oleic, were: 0.44, 0.38, 0.40, 0.32 per cent (average, 0.38 per cent). The solutions were united, mixed with ether and washed five times with 1 per cent sodium carbonate. The ether solution was dried, and the solvent was removed by evaporation at low pressure. The resulting oil appeared to contain no free acid, and proved to be nonirritating when injected into the trachea of the rabbit.

EXPERIMENTAL WORK

Rabbits were found to be most satisfactory for our experiments. A proprietary iso-amylethylbarbituric acid (50 mg. per kilogram), injected intraperitoneally thirty minutes before operating, gave excellent anesthesia. In all cases the trachea was exposed by a small midline incision, under aseptic technic, and the material was introduced into the trachea through a curved Luer needle passed gently downward toward the bifurcation. The head and neck were elevated during the injection so as to prevent, as far as possible, loss by coughing. The neck wound was then sutured. Following this, the animals were carefully watched and autopsy was done within a few hours after death in all cases. Animals unaffected by the injection underwent autopsy after a period varying from two to three weeks.

Group 1.—Two cubic centimeters of sterile peanut oil was injected at body temperature into six rabbits. Death followed in all cases in from twenty-four to seventy-two hours after injection. The two animals that died in twenty-four hours showed intense, generalized hyperemia of the tracheal and bronchial mucous membrane, without exudate. In the remaining animals which died in from forty-eight to seventy-two hours after the injection, the surface of the lungs appeared mottled with red areas of atelectasis. The lymph nodes at the hilus and bifurcation were red and swollen. The trachea and bronchi (fig. 3) were filled with purulent exudate, and the mucous membrane was deeply injected. The microscopic picture (fig. 4) showed the characteristic inflammation of the mucous membranes and infiltration of the alveolar septums with round cells. Scattered areas of atelectasis and emphysema were regularly noted. These changes, therefore, are identical with those described in the autopsy notes in human cases (figs. 1 and 2).

Group 2.—Fat-free residue, suspended in nine parts of sterile normal saline solution, was injected in 2 cc. doses into six rabbits. No clinical reaction was noted. Autopsy after two weeks showed no gross or microscopic reaction in any portion of the lung field.

Group 3.—Mixed fatty acids were injected into six rabbits. Even amounts slightly less than 1 cc. rapidly produced death (within thirty-six hours). Autopsy

showed intense, diffuse tracheobronchitis. The mucous membranes were fiery red and swollen. In most animals small amounts of thick secretions were noted.

Group 4.—Single fatty acids, dissolved in nine parts of liquid petrolatum, were injected at 37 C. Injections of 0.8 cc. of both the oleic and the linolic acid produced death within forty-eight hours, with the marked generalized reaction already noted with the mixed fatty acids. Injection of the solution of solid fatty acids (arachidic, stearic, etc.), however, produced no effect.

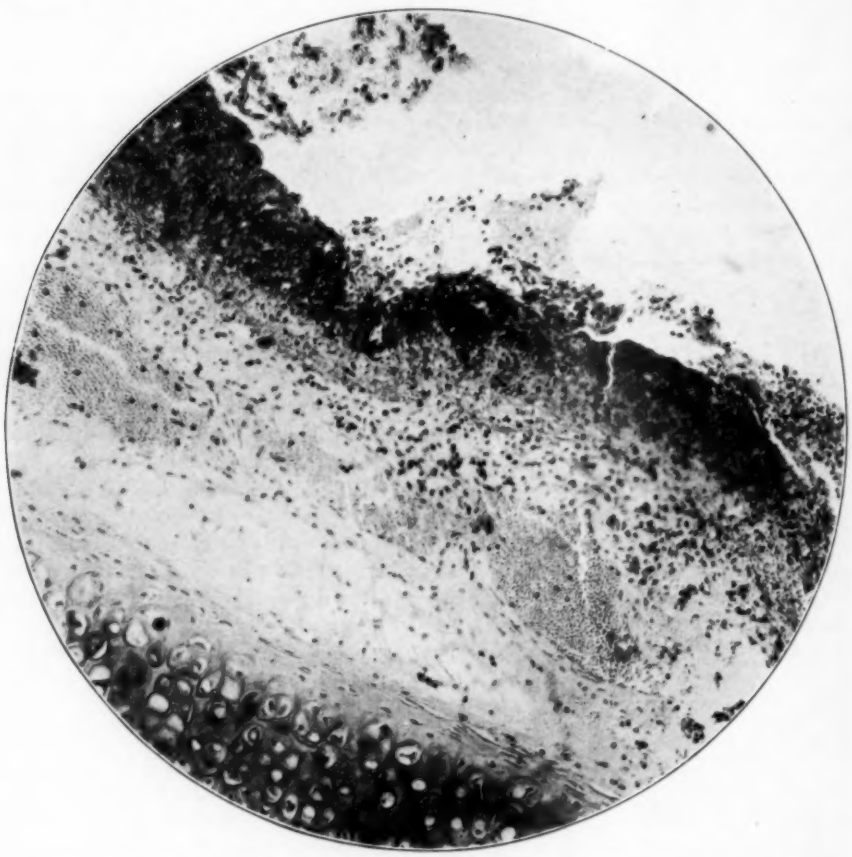

Fig. 3.—Section of the trachea of a rabbit which died forty-eight hours after injection of 0.8 cc. of mixed fatty acid. The changes are the same as those in figure 1. The surface exudate is well shown.

Sterile liquid petrolatum was used as a control, and no reaction was noted clinically or at autopsy three weeks later.

Group 5.—An injection of 0.8 cc. of the soaps of oleic, linolic and the solid fatty acids (5 per cent aqueous solutions) was given to six rabbits. A typical irritative reaction was quickly produced by the soaps of oleic and linolic acid. The soaps of the solid fatty acid, however, solidified at body temperature and the obstruction rapidly produced asphyxiation.

Group 6.—Two cubic centimeters of neutral peanut oil from which the free fatty acids had been removed was injected into each of six rabbits. No effects were noted either clinically or at autopsy.

COMMENT

The latent period in the course of arachidic bronchitis and the extension of the lesion along the bronchi to distant parts of the lung

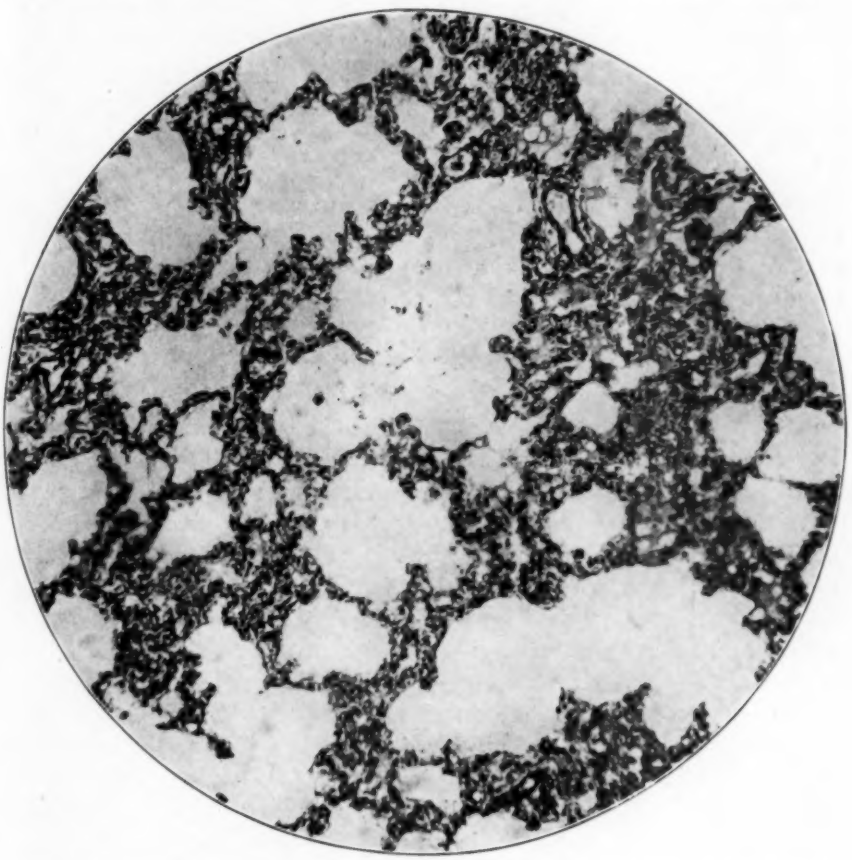

Fig. 4.—Lung tissue from a rabbit which died forty-eight hours after injection of 0.8 cc. of mixed fatty acid. A similar condition was observed after the injection of separated liquid fatty acids. The picture is identical with that seen in human cases (fig. 2).

suggest as a cause of the condition either (*a*) infection or (*b*) the presence of an irritant that is only slightly soluble in the body fluids. It seems unlikely that the reaction is due to a foreign protein, for the following reasons: The clinical picture is highly atypical of such a reaction; skin tests with the protein of peanuts in several of our cases

of arachidic bronchitis have given negative results; the bronchitis is intense in the case of roasted peanuts, in which the proteins have been rendered insoluble by heat; and finally, as our own experiments show, the fat-free residue of raw peanuts, which were prepared so that the protein was little, if at all, denatured, proves to be inert.

Although infection unquestionably plays a rôle in clinical cases of arachidic bronchitis it seems evident from our studies that the primary rôle must be played by the irritating oil. The negative cultures obtained in many animals in which typical lesions had been produced by the chemical irritants indicate this. It is also interesting in this connection to note that the cellular reaction in the bronchial walls of the rabbits is almost exclusively mononuclear; and that in the cases in human beings it was mainly mononuclear. The evidence at hand points to an unsaturated acid present in both the oleic and linolic fractions as the direct causative agent. The free fatty acids of peanut oil, and not those combined as glycerine esters, are the active agents. Our samples of peanut oil contained about 0.5 per cent of the fatty acids in the free form. Lewkowitsch gives as the usual limits from 0.8 to 16.5 per cent for peanut oil.

Pinkerton [9] demonstrated that the reaction of the bronchial tree to an oil "depends (*a*) on the amount of free fatty acid originally present and (*b*) on the rapidity with which free fatty acid is formed (by hydrolysis) in the lung." In the case of simple vegetable oils, such as olive oil, practically no free fatty acid is originally present, and consequently there is no immediate reaction. Chaulmoogra oil, on the other hand, has a particularly high free acid content and produces rapid acute necrosis of the lung tissue. Hydrolysis, according to Lewkowitsch and others, depends principally on two factors—moisture and enzymes. The moist alveolar gases satisfy the first requirement; the lipase present in lung tissue satisfies the second. That oils injected intratracheally may produce a delayed response, owing to the liberation of irritating free fatty acids by hydrolysis, has been well demonstrated by Pinkerton in the case of cod liver oil. It seems clear, nevertheless, from our experiments that little or no effect can be attributed to the hydrolysis of peanut oil in the rabbit. However, the possible rôle of hydrolysis of peanut oil in human cases cannot be denied.

Attention should again be called to the fact that peanut oil deprived of free fatty acids was not irritating in our experiments, whereas oil containing as little as 0.3 per cent free acid was irritating. This is the more significant when we recall the higher concentration of free acid commonly present, according to Lewkowitsch. The low concentration

9. Pinkerton, H.: The Reaction to Oils and Fats in the Lung, Arch. Path. **5**:380 (March) 1928.

of free acid found to be irritating, as well as the wide distribution of the irritant throughout the bronchial tree, indicate the difficulty of discovering a solvent suitable for therapeutic use. Efforts are being directed toward finding a chemical means for overcoming the action of the irritating acid. The use of calcium suggests itself, because of the known effect of calcium ions on inflammation and because of the possibility of the production of a nonirritating calcium soap.

SUMMARY

1. Typical arachidic bronchitis has been produced in the rabbit.

2. Arachidic bronchitis is due to irritation, and infection plays only a secondary rôle.

3. The fat-free residue of peanuts containing unaltered proteins and carbohydrates produces no reaction.

4. The irritant is an acid present in both the oleic and the linolic fraction, and absent in the solid fraction of the fatty acids.

5. Peanut oil containing free fatty acids is irritating. Peanut oil deprived of free fatty acids is not irritating.

6. The concentration of free acid which confers irritating properties on peanut oil may be extremely small, e. g., 0.3 per cent.

DECALCIFICATION OF THE TEMPORAL BONE FOR DISSECTION *

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The anatomy of the temporal bone is complicated and difficult, but a definite knowledge is essential not only to the student but to the aural surgeon. The relationship of the various nerves and vessels to the middle ear, eustachian tube and labyrinth is at times difficult to visualize, and cross-sections of the bone itself are sometimes confusing.

Anatomic specimens of the macerated and dried temporal bone are usually made by means of the gouge, saw, dental burr or a combination of these instruments. This, of course, applies to gross anatomy and not to microscopic sections or to corrosion casts.

In working by means of a gouge and mallet with a temporal bone in a vise, it is not always a simple matter to open up and expose all the cells of the mastoid. If the bone is dry and brittle, the specimen not infrequently cracks or breaks before the operation is completed, especially if it is of the sclerotic type. Even with rongeurs, the danger of cracking is not eliminated.

However, by the use of the dental drill, it is not difficult to remove the cells of the mastoid as in a simple or radical operation with a minimum of risk to the bone. To expose the finer structures even with a drill, such as the facial nerve, cochlea, semicircular canals, etc., is a much more tedious procedure, requiring a considerable amount of time and care, by reason of the position of the parts and the hardness of the bone.

A recent method of decalcification is a material aid, first, on account of the ease with which specimens are cut, and second, because of the shortening of the time required in making the dissections.

Mr. E. L. Judah, curator at McGill University, recently described the following process for decalcifying bone in general and preparing it for dissection, and as far as he knows it is original.[1] Its application to the temporal bone is the reason for this publication. He stated in part:

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* Submitted for publication, Jan. 13, 1930.

1. Judah, E. L.: Notes on Museum Technique, J. Tech. Methods, Bull. Internat. A. Med. Museums **12**:40, 1929. The method was presented at the Twentieth Annual Meeting of the American and Canadian Section, Rochester, N. Y., April 14, 1927.

"The laborious method of chiseling out a bone dissection can be overcome by first decalcifying in a 10 per cent solution of equal parts of commercial hydrochloric and nitric acid." This process takes some days, the length of time varying with the density and hardness of the bone.

"When decalcification is complete, wash the specimen (the temporal bone in this case) overnight in running water and dehydrate in graded alcohol in exactly the same manner as one would a paraffin block for microscopic examination. It is sufficient to commence with 50 per cent alcohol, gradually increasing to 95 per cent absolute alcohol or acetone, and then to xylol." At this stage, it is important that the specimen be perfectly dehydrated.

Fig. 1.—A temporal bone prepared in the manner described on which a simple mastoid operation has been performed. The dissection was completed by means of a sharp scalpel, and the cells widely opened. As may be seen, the bone was pneumatic, the cells having a wide distribution. Some of the cells at the root of the zygoma have been exposed, and the larger terminal ones at the tip. The aditus has been opened, and the cells covering the lateral sinus removed. A specimen of this kind is fairly easily cut, especially if the bone is thin and well decalcified. At times during the dissection, the paraffin becomes "white or stringy" and gives a ragged appearance where it has been cut. This is corrected by holding the specimen over a Bunsen burner for a moment. When the paraffin has melted, the roughened edges become smooth and the lines of incision clear-cut. After allowing the specimen to cool, one can proceed with the dissection. On completion, "the bone is heated thoroughly and placed in cold water or cooled rapidly to remove any ragged end of paraffin.

"The preparation is now placed in melted hard paraffin until it is thoroughly impregnated. Careful watching is necessary that the specimen does not remain in the paraffin too long. It must be fairly soft and slightly pliable; but if left in melted paraffin any length of time there is a tendency to shrink and become hard." When soft, the specimen can be easily dissected with a scalpel, but if shrunken and toughened it becomes almost impossible to cut.

Fig. 2.—A dissection exposing the middle ear, the transverse and part of the descending portion of the facial canal and the horizontal semicircular canal, as well as the upper cells of the mastoid. A specimen of this kind is more difficult to prepare, and the success of the preparation depends in great measure on the decalcification. The bony capsule of the labyrinth, in particular, is dense and at best not easy to cut. Once a bone is prepared by the method described, it can be kept for a long time and cut at leisure. It enables a student of otology to gain a knowledge of the distribution of the cells of the mastoid without the tedious procedure of chiseling with a gouge and mallet. After a little experience has been gained, a simple mastoid operation can be completed with a sharp knife in a short time. Detailed dissections require greater care and patience, but once obtained and mounted, form beautiful specimens for museum or demonstration purposes.

To remove the superfluous paraffin "the bone is hung in a paraffin oven for a short time to allow any excess to run out especially from the spongy tissue." The preparation is now ready for dissection and all that is needed is a sharp scalpel.

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SIMPLE MASTOID WOUND

POSTOPERATIVE MANAGEMENT, WITH A DETAILED ANALYSIS OF SIXTY-SEVEN CASES *

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The after-treatment for mastoid operations has been spoken of as an art. Although I have not thought of the employment of means to bring about satisfactory conclusions of simple mastoid operations as an art, I have given a great deal of thought to the matter of aiding Nature in this respect.

The objects sought for are: sound scars, good cosmetic results and the shortest possible convalescence, at all times staying within the bounds of reasonable surgical judgment.

Considering the number of "sick days" spent during convalescence from simple mastoid operations, it is surprising to note how little space has been devoted to the consideration of the management of the simple mastoid wound in thirty contributions to the literature published during the interval from 1906 to 1926.

Judging from the text of these articles and from my observations, ideas with regard to postoperative care are at great variance. In so far as possible, standardized management would be of great value especially to the otologist practicing outside the larger medical centers. In these communities, any method of treatment not productive of practically 100 per cent satisfactory end-results is often of unfortunate and far-reaching consequences not experienced in large cities.

POSTOPERATIVE TECHNIC

Only through the removal of all necrotic bone and the obliteration of pockets and recesses so that drainage is established for the most deeply seated cell, surgically accessible, is the stage set for a satisfactory postoperative period. Anatomic peculiarities will continue to baffle the operator in many instances, and will be the chief factor in disappointing, even tragic, results, just as long as one patient with acute suppurative otitis recovers, and another has complications following operation on the mastoid. In fact, as one reviews his work one is struck with the

* Submitted for publication, Oct. 9, 1929.

* Candidate's thesis, the American Laryngological, Rhinological and Otological Society, Inc., submitted November, 1928.

thought that septic or intracranial complications are more influenced by chance than by the pathologic changes observed at primary operation.

The number of cases in which one can be certain that the aditus becomes shut off from the area operated on, obliterating the antrum permanently, can be determined only by leaving the wound widely open and watching the granulations mechanically obstruct its distal end. Too often while pursuing this method of postoperative treatment the operator will experience the disappointment of seeing this small area of granulation tissue break down as a result of a new infection or reinfection of the middle ear, or because the newly formed blood vessels in this tissue necessarily find their origin within a lesser radius than if the wound were closed, even partially, in its uppermost part. A purposeful effort to shut off the middle ear from the mastoid cavity means more routine instrumentation in the aditus than many are willing to execute. In fact, its execution is not unattended with danger in young patients, as thorough and complete destruction of this mucosa as well as that of the antrum is necessary. Only time will determine how thorough has been this destruction. It is my opinion that the great majority of mastoid antrums are restored in the healing process, and that Nature closes the entire wound more readily when this method of repair is permitted.

Many preparations from alcohol to zinc have been used as irrigating solutions for the simple mastoid wound, including the dye preparations and vaccines. Clinical evidence is lacking, however, that any antiseptic used as such promotes safer or more rapid convalescence. The influence of natural healing rather than the preparation used is the determining factor. Irrigation, however, does remove mucus and infected material mechanically, in event the granulations are not sterile, and dislodges spicules of bone which occasionally find their way to the surface.

Five per cent iodoform gauze seems a most satisfactory material for a primary dressing and is used by the great majority of operators as a "packing," or at least as a "drain," regardless of sinus or dural exposures. This drug, however, has been accused of being responsible for the development of complicating erysipelas. The most, or the least, that can be said for iodoform used in a surgical dressing material in a bony wound is that it is somewhat irritating, which is not an unwelcome property, and that it inhibits bacterial development. Instances of iodoform poisoning are rare and are not serious.

The trend of the times seems to be to close rather thoroughly the simple mastoid incision, so that, in a sense, a part of the technic of the so-called blood clot dressing is adopted, but not purposely.

From the day I saw the blood clot operation and dressing demonstrated and was instructed to open the wound when the temperature

reached 105 F., I considered this method of treatment for a wound an unsurgical and unsafe procedure.

It is unreasonable to suppose that irrigation of the wound with any antiseptic solution, prior to suturing, whether the same traverses the middle ear or not, sterilizes the surfaces involved, making safe the closure of such a wound. If this is done one gambles on Nature's ability to sterilize the infected clot that forms promptly.

Undoubtedly, aided by the removal of the great mass of infected structure Nature is able to bring about this result in some cases. All depends, however, on the character of the infection and the resistance of the patient and whether or not the process has been of sufficient duration so that Nature may have thrown out a perfect barrier of resistance against deep-seated complications. This barrier must not have been broken down by the surgical operation. The determination of these factors prior to the attempt to close a mastoid wound in this manner is impossible, so that if this is done, a satisfactory end-result is a matter of good luck rather than good judgment.

It would also seem unsurgical to attempt to bring about or to permit closure of a mastoid wound in the great majority of cases, or even to shut off the aditus prior to the cessation of discharge through the drum membrane into the external auditory canal. In the presence of such tympanic suppuration, all the necessary elements are again present for a repetition of the process for which the simple mastoid operation was performed. "Posterior drainage" was called for preoperatively, and Nature should not be prevented from maintaining such, so long as she will.

That results of value are ever attained from the use of suction applied routinely to the external auditory canal is doubtful. When the tympanic mucosa, as a result of the influence of no force except that of inflammatory reaction, becomes so distended and thrown into folds as actually to prolapse through a myringotomy incision, one should hesitate to apply a physical force that might bring about such a result more readily. Four times within two years I have noted this development, necessitating amputation of this portion of the mucosa which essentially had become a polyp, and which, of course, materially interfered with drainage. Recovery was then prompt in each case.

Likewise it is doubtful if any antiseptic used as such, or any fluid used for its mechanical effect, can be introduced with any degree of exactness into the middle ear and antrum through a myringotomy incision. On occasions I have introduced fluid into these cavities, most often by accident, and always via the mastoid wound. These patients complained almost uniformly of pain that did not seem commensurate with any benefit apparent subsequently.

The majority of patients with infections of the middle ear, with or without operations on the mastoid, recover without the introduction of any material into the cavity in the middle ear, except, on occasions, at the time of an operation on the mastoid. This phenomenon proves that the element, and likely the only element, necessary to bring about recovery, outside of drainage, is the natural defensive and reparatory effects of Nature.

If it should be determined that a given wound is best cared for by a thorough process of rather firm and oft repeated packings, no better method can be pursued than one in which a surgical solution of chlorinated soda is used and a modification of the original technic followed, as used so extensively in bone wounds, the result of injuries during the

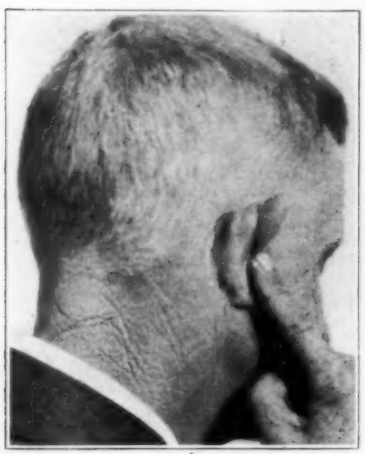

Figure 1

Figure 2

Fig. 1.—Firm scar obtained after dressing wound with solution of chlorinated soda.

Fig. 2.—Firm scar obtained after dressing wound with solution of chlorinated soda.

World War. Undoubtedly this method of treatment is far more certain of thorough and solid healing in a given case than any other.

After a few dressings in which the wound has been packed with a strip of plain selvaged, ½ inch (1.27 cm.) gauze, saturated in this solution, granulation appears of a character not seen when any other medicant is used. This salmon pink granulation is "bloodless" to the extent that it may be literally scrubbed with a gauze sponge without bleeding, and is practically anesthetic. This granulation tissue becomes sterile early in the process and in the end produces the firmest scar tissue possible; naturally, because of these characteristics the entire healing process is much prolonged and the end-results of wounds cared for in this manner are often not unlike those shown in figures 1 and 2.

Although this method of management of the simple mastoid wound is most certain with regard to end-results, for obvious reasons it is not practical to employ the same as a routine in private otologic practice.

With a good deal of surprise and satisfaction it was noted how readily and satisfactorily simple mastoid wounds would close if treated along the general line so long followed in the postoperative management of disease of the nasal accessory sinuses; namely, by providing for aeration and drainage. For most of the period of convalescence aeration and drainage may be efficiently provided for in the manner to be described.

Fig. 3.—Mastoid dressing, left, viewed externally; enlarged one-fourth.

After a primary dressing of iodoform gauze, at which time the wound is closed with deep silkworm gut sutures except in its lowermost part, an effort being made to include the periosteum, alternating with skin clips, the dressing shown in figures 3, 4 and 5 may be adopted.

The primary dressing is not completely removed, as a rule, until the fourth day, the outer dressing being changed daily; the silkworm sutures are removed on the second and third days, and the skin clips on the fourth day.

I now use the dressing illustrated as a routine procedure after the primary dressing. This dressing consists only of a segment of a rubber catheter, of suitable size and length and fenestrated, and a double kidney-

Fig. 4.—Mastoid dressing, left, viewed posteriorly; enlarged one-fourth.

Fig. 5.—Mastoid dressing, left, viewed mesially; enlarged one-fourth.

shaped layer of ordinary bandage material perforated in its center. After surface sterilization and wound irrigation, the distal end of the rubber tube is introduced into the antrum and its proximal end is passed through the perforation in the bandage material to which it adheres by means of a "liquid adhesive" preparation. Application of this preparation about the margin of the gauze likewise fixes the dressing to the skin. Because of the remarkable and generally satisfactory behavior of the new formation tissue stimulated by the properties of solution of chlorinated soda, this drug is recommended as the irrigant.

Obviously, aeration and drainage are possible uninterruptedly. Should the catheter become plugged, it is a simple matter for the patient

Fig. 6.—Strip of gauze, three-fourths inch thick, which holds dressing in place, is shown applied to patient.

to introduce a sterile toothpick, probe or applicator into the antrum to restore its patency, and by the use of a small syringe irrigation or suction is possible if such a procedure seems indicated. Proper hygiene of the external auditory canal is likewise permitted from the outset.

If "neglect" of such a wound happens through inability of a patient to present himself for dressings, the disadvantages of a "mastoid dressing" of pus-soaked packing, gauze and bandage, foulness, excoriated skin and an auditory canal filled with stagnant pus are obviated.

After a time a strip of gauze, three-fourths inch (18.7 cm.) in length and one-half inch in width, will hold this dressing in place, as shown in figure 6.

Solution of chlorinated soda used on packing material or as an irrigant has not, in my hands, caused any disturbance of the skin. This

undesirable result has been observed only in cases in which oil was used as the vehicle.

It is surprising to note the tremendous quantity of secretion that will find its way out of a simple mastoid wound when the aforementioned provisions are made for its escape. Almost a constant drip is occasionally observed during the first few days, so that protection of the clothing of the neck and shoulder may be necessary.

So great is the quantity of this material that, if once observed, the chances taken in a blood clot dressing and the disadvantages of a "mastoid dressing" as illustrated in textbooks become so apparent that one is likely never to give consideration to them again if other circumstances will permit.

The time during which drainage through rubber tubing is called for is indicated entirely by the quantity of drainage which is at first purulent,

Fig. 7.—Sixteen days after skin closure.

later seropurulent and serous and finally ceases. At this time the use of the tubing is entirely abandoned. One-half or one-fourth segment of such a drainage tube or even a portion of a small rubber band may be used toward the end. Figures 7, 8, 9 and 10 show end-results obtained in this method of wound management. These photographs show a striking absence of deformity.

A "drain" or "wick" of gauze used for the purpose of "drainage" eventually becomes a plug as the healing process advances. This never becomes a fact in the use of a rubber tubing or a segment thereof.

OBSERVATIONS ON SIXTY-SEVEN CASES

The accompanying table gives a detailed analysis of sixty-seven consecutive cases, from office practice, drawn from an area within a radius of approximately 10 miles in southeastern Connecticut, with a population

of about 155,000, from January, 1921, to July, 1926, giving an outline of the preoperative history and postoperative course.

In this group of sixty-seven cases, simple mastoid operations were done for relief from acute surgical mastoiditis complicating acute sup-

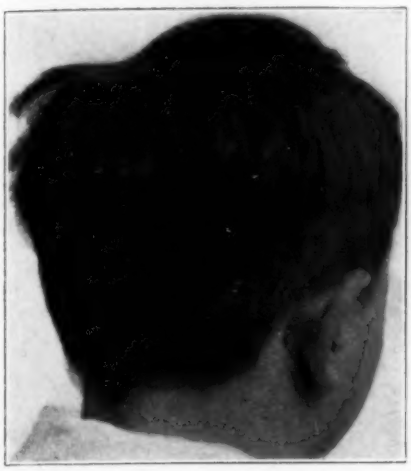

Figure 8

Figure 9

Fig. 8.—Eighteen days after skin closure.

Fig. 9.—Sixty-nine days after skin closure.

Fig. 10.—Ninety days after skin closure.

purative otitis media in sixty-three patients. These operative mastoids developed as a complication in 828 cases of acute suppurative otitis media, encountered during six years of practice from Jan. 1, 1921, to Jan. 1, 1927. Strikingly, 31.33 per cent came to operation during the first six months of 1926, while all patients with acute suppurative disease of the middle ear encountered during the balance of that year recovered.

Detailed Analysis of Patients Seen from January, 1921, to July, 1926

Case	Age	Sex	Ear	Date of Onset	When First Seen	Acute Purulent Otitis Media, Complications	Myringotomies Before Operation	Blood Count	Roentgenogram	Interval Between Onset and Operation	Date of Operation	Exposures	Organism	Healing Time and Date	Complications During Period of Healing; Subsequent History
1921: Acute Purulent Otitis Media, 38; Mastoids, 10															
1	6	F	Right	1/23/21	1/30/21	Grip	Two	.....	.....	19 days	2/11/21	.....	.....	71 days 4/22/21	During convalescence: diphtheria; 4/5/21, part of wound broke down
2	56	F	Right	2/23/21	2/27/21	Pernicious anemia	Ruptured, one	Erythrocytes, 1,500,000; leukocytes, 20,800; hemoglobin, 35%	.....	20 days	3/15/21	.....	.....	Died, 5 days 3/20/21	
3	17	F	Left	2/25/21	3/ 7/21	Tonsillitis	Ruptured, one	.....	.....	14 days	3/11/21	.....	.....	83 days 6/4/21	
4	6	F	Right	3/ 3/21	3/11/21	"Head cold"	Ruptured, one	.....	.....	18 days	3/21/21, subperiosteal abscess	Dura	.....	111 days 7/2/21	After recovery: 3/19/22, myringotomy; 3/26/22, myringotomy; 4/29/22, healed
5	4	M	Left	3/26/21	3/27/21	10 days postoperative tonsillectomy—discharge 3 days—dry 10 days, reappearing with mastoid swelling	One	.....	.....	21 days	4/16/21	Sinus	Hemolytic streptococcus	43 days 5/29/21	During convalescence: 4/29/21, acute articular rheumatism; after recovery: pus in mastoid scar; 9/3/22, myringotomy, healed 9/13/22; 5/20/24, myringotomy, healed 5/25/24; 4/9/26, myringotomy, healed 4/12/26
6	4	M	Left	4/ 5/21	4/ 5/21	Scarlet fever	Ruptured, two	.....	.....	19 days	4/24/21	.....	.....	64 days 7/8/21	
7	11 mo.	F	Right	3/17/21	4/ 8/21	"Head cold"	Ruptured	.....	.....	21 days	4/8/21, subperiosteal abscess	.....	.....	53 days 5/31/21	After recovery: 3/3/22, myringotomy; 3/13/22, pus in mastoid scar; 3/20/22, healed; 1/8/24, myringotomy; 1/14/24, healed
8	7	M	Left	5/16/21	5/18/21	Grip	One	.....	.....	25 days	6/11/21	.....	.....	81 days 8/31/21	
9	21	M	Left	7/14/21	7/27/21	Bathing	One	.....	.....	13 days	7/27/21	.....	.....	91 days 10/28/21	
10	3	M	Right	10/28/21	11/ 2/21	Grip	Ruptured, one	.....	.....	21 days	11/19/21	.....	.....	73 days 1/15/22	After recovery: 3/3/22, myringotomy; 3/29/22, healed

							1922: Acute Purulent Otitis Media, 89; Mastoids, 5								
11	25	F	Right	1/16/22	1/17/22	Tonsillitis	Ruptured, three	.....	Negative	26 days	2/12/22	Sinus	Hemolytic streptococcus	56 days 4/8/22	During convalescence: subacute articular rheumatism
12	22	F	Left	12/25/21	1/29/22	Grip	Ruptured	.....	.....	35 days	1/30/22	Sinus	.....	52 days 3/21/22	
13	29	F	Right	2/27/22	2/27/22	Grip; postpartum, 5 days	One	Red blood cells 3,330,000; no pathologic cells	Positive	31 days	3/28/22	Dura	Staphylococcus	47 days 5/5/22	
14	4	M	Left	6/11/22	6/21/22	"Head cold"	Ruptured, two	.....	Negative	102 days	9/23/22	.....	.....	22 days 10/15/22	
15	7	M	Left	8/25/22	11/ 9/22	"Head cold"	Ruptured	.....	Negative	95 days	12/1/22	Dura	Staphylococcus	46 days 1/17/23	
							1923: Acute Purulent Otitis Media, 145; Mastoids, 14								
16	5	M	Left	1/17/23	1/17/23	Grip	One	Normal	Negative	6 days	1/23/23	Sinus	Nonhemolytic streptococcus	120 days 5/23/23	Stormy convalescence in hospital with headache; physical signs all presented in tympanum and deep canal
17	67	M	Right	6/15/22	1/ 6/23	Grip	Ruptured	.....	.....	210 days	1/7/23, subperiosteal abscess	Sinus; dura	.....	113 days 4/30/23	
18	15	M	Right	1/12/23	1/12/23	Grip	Ruptured, three	White blood count, 18,000	Negative	15 days	1/27/23	Dura	Staphylococcus, aural canal; streptococcus, mastoid	70 days 3/7/23	During convalescence: 2/10/23, beginning of septic endocarditis, tubercular hip
19	2	M	Left	1/15/23	1/29/23	"Head cold"	Ruptured, one	.....	.....	17 days	2/2/23, subperiosteal abscess	.....	Yellow staphylococcus	64 days 4/6/23	
20	3	M	Left	2/27/23	2/27/23	Nasal diphtheria	Ruptured	.....	.....	6 days	3/3/23	.....	.....	72 days 5/15/23	After recovery: 12/9/23, myringotomy; pus in mastoid scar; 1/3/24, healed
21	19	M	Right	2/11/23	2/28/23	Grip	Ruptured	.....	.....	17 days	2/28/23	.....	.....	86 days 5/24/23	During convalescence: 5/4/23, explored zygoma region under ether
22	8	F	Right	3/14/23	3/16/23	Grip	One	White blood count, 12,600; polymorphonuclears, 84%	.....	24 days	4/8/23	.....	Staphylococcus	21 days 4/29/23	

Detailed Analysis of Patients Seen from January, 1921, to July, 1926—Continued

Case	Age	Sex	Ear	Date of Onset	When First Seen	Acute Purulent Otitis Media, Complications	Myringotomies Before Operation	Blood Count	Roentgenogram	Interval Between Onset and Operation	Date of Operation	Exposures	Organism	Healing Time and Date	Complications During Period of Healing; Subsequent History
23	2	M	Right	3/29/23	3/30/23	"Head cold"	Two	.....	Positive	13 days	4/12/23	Sinus	Streptococcus	50 days 6/2/23	After recovery: 10/1/23, myringotomy refused
24	40	F	Left	4/ 4/23	4/ 5/23	"Head cold"	Two	.....	.....	53 days	5/27/23	.....	Nonhemolytic streptococcus	72 days 8/9/23	
25	5	M	Right	4/20/23	4/25/23	Measles	Ruptured	.....	Negative	16 days	5/6/23, subperiosteal abscess	Dura	.....	61 days 7/7/23	
26	6	M	Left	5/23/23	5/22/23	"Head cold"; postoperative tonsillectomy, eight days	One	White blood count, 14,800	.....	38 days	6/6/23	.....	Streptococcus	Died; 24 days 7/1/23, streptococcus meningitis	During convalescence: tympanum dry in one week; 6/24/23, direct transfusion; 6/17/23, myringotomy; 6/23/23, meningeal headache; 6/28/23, streptococcus in spinal fluid
27	4	F	Left	6/ 1/23	6/ 1/23	Scarlet fever	Ruptured, one	.....	.....	20 days	6/21/23	.....	Streptococcus	42 days 8/3/23	
28	1½	M	Right	7/10/23	7/10/23	"Head cold" ? 3 days after vaccine treatment; chronic purulent otitis media on right	Ruptured, three	.....	.....	21 days	7/31/23	Sequestrum; posterior canal	.....	5 years; 7/31/28, pinpoint opening through scar, secretion, large posterior drum membrane, perforation, secretion	During convalescence: whooping cough; right facial paralysis 3 months after operation; recovered
	3	M	Left	1/16/25	1/16/25	.....	One	.....	.....	19 days	2/5/25	Dura	.....	Drum closed in 1¼ years; wound closed in 2 years	
1924: Acute Purulent Otitis Media, 115; Mastoids, 8															
29	25	F	Right	12/24/23	1/22/24	Grip	Ruptured	White blood count, 12,500; polymorphonuclears, 83%	.....	30 days	1/24/24, subperiosteal abscess	.....	.....	35 days 2/29/24	

30	6	F	Both	2/19/24	2/26/24	Tonsillitis	One; both	White blood count, 18,000	.....	24 days	3/13/24, double mastoid	Sinus, right	Hemolytic streptococcus	120 days 6/15/24	After recovery: 2/10/25, myringotomy right (healed 2/28/25); 6/19/25, ruptured left; 6/23/25, pus in mastoid scar; 7/31/25, healed
31	4	F	Left	2/25/24	2/29/24	Tonsillitis	One	White blood count, 18,900; polymorphonuclears, 78%	.....	29 days	3/28/24	.....	Nonhemolytic streptococcus	106 days 6/1/24	During convalescence: pleural effusion, hemolytic streptococcus; after recovery: 2/10/25, myringotomy; 2/15/25, pus in mastoid scar; 3/18/25, healed
32	1	F	Left	3/16/24	3/20/24	"Head cold"	Ruptured	White blood count, 23,000	.....	21 days	3/21/24, subperiosteal abscess	.....	Pneumococcus type II	68 days 5/29/24	During convalescence: erysipelas about wound and left leg; after recovery: 6/12/24, myringotomy, pus in mastoid scar; 6/25/24, healed
33	7	F	Right	4/17/24	4/17/24	Grip	Ruptured	White blood count, 17,500; polymorphonuclears, 76%	.....	16 days	5/3/24	Sinus; dura	Nonhemolytic streptococcus	64 days 5/28/24	
34	10	M	Right	5/ 3/24	5/12/24	Scarlet fever	Ruptured	White blood count, 9,500; polymorphonuclears, 72%	Positive	13 days	5/16/24	.....	Nonhemolytic streptococcus	Died; 22 days 6/7/24	Streptococcus meningitis
35	34	F	Left	10/15/24	11/28/24	"Head cold"	Ruptured	.....	.....	43 days	11/28/24	.....	Pneumococcus type III	60 days 1/28/25	
							1925: Acute Purulent Otitis Media, 161; Mastoids, 9								
36	9½ mo.	F	Right	1/ 7/25	2/ 5/25	Grip	Ruptured, one	.....	.....	39 days	2/18/25	.....	.....	64 days 4/22/25	After recovery: 12/19/25, myringotomy; 1/3/26, pus in mastoid scar; 1/23/26, tonsil and adenoid operation; 1/27/26, healed; 12/11/26, myringotomy; 12/13/26, healed; 5/2/27, myringotomy; 5/23/27, healed; 12/4/27, myringotomy; 1/18/28, healed
37	9	M	Left	2/10/25	2/10/25	Whooping cough	One	.....	.....	38 days	3/18/25	.....	Hemolytic streptococcus	44 days 4/22/25	During convalescence: 3/31/25, myringotomy
38	16	M	Left	2/15/25	2/15/25	Grip	One	White blood cells, 34,600; polymorphonuclears, 92%; 6,800; 18,000	Negative	21 days	3/6/25	.....	Hemolytic streptococcus	Wound healed, 66 days, 6/10/25; died; 129 days, 7/15/28; brain abscess	During convalescence: several direct transfusions; 3/28/25, jugular ligation; 5/1/25, cerebral exploration

Detailed Analysis of Patients Seen from January, 1921, to July, 1926—Continued

Case	Age	Sex	Ear	Date of Onset	When First Seen	Acute Purulent Otitis Media, Complications	Myringotomies Before Operation	Blood Count	Roentgenogram	Interval Between Onset and Operation	Date of Operation	Exposures	Organism	Healing Time and Date	Complications During Period of Healing; Subsequent History
39	8	M	Right	2/ 9/25	2/16/25	"Head cold"	One	White blood count, 46,000; polymorphonuclears, 92%	.....	7 days	2/16/25	.....	Hemolytic streptococcus	68 days 4/21/25	
40	8	M	Right	1/ 1/25	2/26/25	Grip ?; indisposed, headache 8 weeks	Ruptured	.....	.....	55 days	2/26/25	Sinus	.....	59 days 4/20/25	
41	18 mo.	F	Right	3/ 6/25	3/ 9/25	Grip	One	.....	.....	16 days	3/22/25, subperiosteal abscess	.....	.....	66 days 5/28/25	
42	2½	F	Right	2/20/25	3/11/25	Scarlet fever	Ruptured, one	White blood count, 22,700; polymorphonuclears, 88%	.....	44 days	4/4/25, subperiosteal abscess	.....	.....	27 days 5/1/25	
43	8	M	Right	2/26/25	3/15/25	"Head cold"	One	.....	.....	20 days	3/16/25	.....	Hemolytic streptococcus	45 days 5/1/25	
44	10 mo.	M	Left	12/ 4/25	12/11/25	"Head cold"	Ruptured	.....	.....	10 days	12/14/25, subperiosteal abscess	.....	Nonhemolytic streptococcus	46 days 1/30/26	
						1926: Acute Purulent Otitis Media, 280; Mastoids, 21									
45	9½	M	Left	12/13/25	12/13/25	Grip	One	White blood count, 18,800; polymorphonuclears, 77%	Positive	24 days	1/7/26	Sinus	Nonhemolytic streptococcus	20 days 1/27/26	
46	5	F	Right	12/18/25	12/18/25	Measles	Ruptured, three	White blood count, 59,200; polymorphonuclears, 80%	Positive	21 days	1/9/26	.....	Hemolytic streptococcus	42 days 2/21/26	
47	5	F	Both	12/24/25	12/24/25	Measles	One, both	White blood count, 33,000; polymorphonuclears, 72%	Positive, two	20 days	1/14/26, double mastoid	Dura, right	Pneumococcus type IV	108 days 4/22/26	During convalescence: 1/22/26, direct transfusion

48	11 mo.	F	Right	12/24/25	12/24/25	Grip	One	.....	.....	33 days	1/27/26	.....	Hemolytic streptococcus	22 days 2/19/26	After recovery: 11/30/26, myringotomy; 12/2/26, healed
49	10	M	Right	12/25/25	12/27/25	Grip	One	.....	.....	31 days	1/12/26	.....	.....	70 days 3/22/26	
50	22	F	Right	12/29/25	12/29/25	Grip	Three	White blood count, 22,000; polymorphonuclears, 88%	.....	26 days	1/25/26	.....	Hemolytic streptococcus	63 days 3/28/26	
51	7	F	Right	12/23/25	1/12/26	Measles	Ruptured	.....	Positive	19 days	1/12/26, subperiosteal abscess (opened by general surgeon); polyarthritis; septicemia; endocarditis	Sinus opened jugular tied	Hemolytic streptococcus	Died; 1 day 1/13/26; peritonitis	
52	16	F	Right	1/12/26	1/14/26	Grip	Three	White blood count, 17,200; polymorphonuclears, 79%	.....	23 days	2/5/26	.....	Hemolytic streptococcus	70 days 4/15/23	During convalescence: 3/2/26, myringotomy; 3/20/26, myringotomy; after recovery: 4/12/27, myringotomy, swelling in mastoid; 5/3/27, healed
53	17 mo.	F	Left	1/ 6/26	1/16/26	Grip	Ruptured	.....	.....	10 days	1/16/26, subperiosteal abscess	.....	.....	57 days 3/13/26	After recovery: 3/19/26, myringotomy, pus in mastoid scar; 3/28/26, healed; 6/10/26, myringotomy; 6/16/26, healed
54	7	M	Left	1/16/26	1/16/26	"Head cold"	Two	.....	.....	16 days	2/2/26, cortical perforation	.....	Nonhemolytic streptococcus	52 days 3/24/26	
55	23 mo.	M	Right	1/28/26	2/ 4/26	Measles	One	.....	.....	48 days	3/16/26, cortical perforation	.....	Hemolytic streptococcus	39 days 4/25/26	
56	10	M	Right	12/21/25	2/ 6/26	Grip	Ruptured	White blood count, 18,500; polymorphonuclears, 73%	.....	45 days	2/6/26	.....	.....	72 days 4/18/26	
57	5	F	Left Right	2/ 3/26	2/ 8/26	Scarlet fever	One One	White blood count, 31,550; polymorphonuclears, 91%	.....	19 days 44 days	2/22/26 3/17/27	.....	Hemolytic streptococcus	Died 4/8/26; nephritis; exhaustion	During convalescence: measles; nephritis

Detailed Analysis of Patients Seen from January, 1921, to July, 1926—Continued

Case	Age	Sex	Ear	Date of Onset	When First Seen	Acute Purulent Otitis Media, Complications	Myringotomies Before Operation	Blood Count	Roentgenogram	Interval Between Onset and Operation	Date of Operation	Exposures	Organism	Healing Time and Date	Complications During Period of Healing; Subsequent History
58	2 mo.	M	Right	?	3/ 4/26	?	One	.....	.....	Refused advice until	3/22/26	.....	.....	Died; 31 days 4/20/26; toxemia; exhaustion	During convalescence: streptococcus cellulitis; extensive sloughing of entire scalp
59	13	F	Right	3/ 3/26	3/ 4/26	Measles	One	White blood count, 20,400; polymorphonuclears, 75%	Positive	16 days	3/18/26	.....	Hemolytic streptococcus	25 days 4/13/26	
60	5	M	Right	3/28/26	3/28/26	Grip	One	White blood count, 20,400; polymorphonuclears, 82%	.....	19 days	4/17/26	.....	Hemolytic streptococcus	47 days 5/27/26	
61	3	M	Right	3/19/26	4/10/26	Scarlet fever	Ruptured, one	.....	.....	24 days	4/13/26	.....	.....	.....	After recovery: large areas of inner plate sequestered through granulations, large perforation healed with thin scar; 3/26/27, myringotomy ruptured; 4/1/27, healed; 1/17/28, myringotomy; 1/28/28, pus in mastoid scar; 2/4/28, healed
62	33	F	Left	5/ 3/26	5/17/26	Grip	Two	.....	.....	18 days	5/21/26	.....	Hemolytic streptococcus	36 days 6/27/26	
63	3	M	Right	5/22/26	6/ 4/26	Tonsillitis	One	.....	.....	12 days	6/4/26, subperiosteal abscess	.....	Hemolytic streptococcus	32 days 7/6/26	During convalescence: 6/17/26, drum ruptured; 7/6/26, healed

Summary of Table

Number of cases of acute purulent otitis media		828
Ruptured	133	
Incised	695	
Number of patients		63
Number of mastoid operations		67
Ages:		
Range		From 2 months to 56 years
Average		9 years
Sex:		
Female		33
Male		30
Ear:		
Right		29
Left		28
Complications:		
Grip		25
Head cold (grip ?)		15
Scarlet fever		10
Measles		7
Tonsillitis		6
Whooping cough		1
Nasal diphtheria		1
Sea bathing		1
Pernicious anemia		1
Drum Membrane:		
Ruptured		32 (in 133)
Myringotomy (one or more)		35 (in 695)
Roentgenogram:		
Positive		7
Negative		4
Interval between Onset and Operation:		
Range		From 6 to 210 days
Average		27 days
Exposures:		
Sinus		12
Dura		8
Invading Organism:		
Hemolytic streptococcus		22
Nonhemolytic streptococcus		8
Staphylococcus		4
Pneumococcus type II		1
Pneumococcus type III		1
Pneumococcus type IV		1
Healing Time:		
Range		From 21 to 172 days
Average		61 days
Recoveries		57
Deaths		7
Cause of: case 2, pernicious anemia; case 23, meningitis streptococcus; case 34, meningitis streptococcus; case 38, abscess, brain temporo-sphenoidal; case 51, septicemia (24 hour death); case 57, nephritis; case 58, toxemia, streptococcus cellulitis		
Patients suffering from subsequent acute purulent otitis media		16
Number of attacks		26
Complicated by infection in mastoid scar		9
Intact drum membranes		57

In these 828 cases with an acute condition of the ears the drum membrane had been permitted to rupture in only 133 (16 per cent +) before treatment was sought, showing that, as a rule, patients with this disease of the ear present themselves for treatment early in the course.

Thirty-three of this number came to mastoid operation, or one case in four, while of the 695 in which incision was made before rupture, thirty-five came to mastoid operation, or one in twenty.

By her treatment, Nature had established satisfactory surgical drainage in only thirty-six (4.3 per cent).

The number of recoveries without the development of a mastoiditis requiring surgical intervention was 761 (91.9 per cent).

The percentage requiring surgical intervention was 8, in which group there were seven deaths, five due directly to complications of otitic suppuration (7.93 per cent).

In every instance, the performance of the simple mastoid operation was decided on the basis of clinical evidence of surgical disease. Laboratory work, including the roentgen examination, was done only in those cases in which the indications were not clear, or when demanded by the patient or the family.

Clinical grip as a constitutional disease headed the list of exciting causes, exceeding scarlet fever two and one-half times as the forerunner of suppuration of the middle ear.

If the cases of those patients who considered their condition due to a "head cold" are considered as upper respiratory grip, grip accounted for 59.7 per cent of this group of simple mastoid operations. Scarlet fever accounted for 14.9 per cent, measles 10.4 per cent, tonsillitis 8 per cent, and whooping cough, nasal diphtheria, sea bathing and pernicious anemia, each 1.5 per cent.

The roentgenologic evidence of surgical mastoid disease failed to agree with the clinical evidence in 36.3 per cent. The lateral sinus was exposed twelve times, the dura eight, either by the disease or because the destructive process had rendered the inner plate so thin that the removal of a portion of it became necessary as its continuity was broken in the course of operation.

In no case did these exposures influence septic or intracranial complications, except in case 18, in which death followed in twenty-four hours. Had this mastoid been opened surgically prior to the development of sepsis the outcome might have been altered.

The invading organisms identified from mastoid wounds were: hemolytic streptococcus, 0.57+; nonhemolytic streptococcus, 0.21+; staphylococcus, 0.10+; pneumococcus type II, 0.02+; pneumococcus type III, 0.02+, and pneumococcus type IV, 0.02+ per cent.

After recovery, sixteen patients suffered with twenty-six suppurative infections of the middle ear, in nine of whom infection developed in the mastoid scar. All of the conditions were healed by simple drainage.

The patient in case 4 had an intact drum membrane, so far as is known, from April 29, 1922, to Oct. 5, 1928, on which day one-sixteenth inch of posterior segment was apparently "blown out" by a too deliberate autopolitzeration, "in an effort," the patient said, "to dislodge water which found its way into my nose while I was shampooing my hair."

The patient in case 28 now shows a destruction of one third of the postero-inferior segment of the drum membrane.

In case 61, after destruction of three fourths of the drum membrane, the tympanum was shut off completely by new formation tissue. On Jan. 17, 1928, another acute suppurative infection destroyed all of this tissue.

Practical hearing defects existed only in the right ear in case 28, and in case 61; they were uninfluenced by treatment. An oval defect, one fourth of the drum area in the inferior segment, existed on Oct. 11, 1928.

An annoying tinnitus was present in case 21.

The wounds in cases 54, 55, 59, 60, 62 and 63 were dressed with the tube dressing described until the closure of the wound, with an average healing period of thirty-nine days against sixty-five days from the rest of the series.

SUMMARY

1. The objects sought were: sound scars, good cosmetic results and the shortest possible convalescence.

2. Standardized management would simplify matters for both patient and physician.

3. A thorough and complete mastoid operation is essential to satisfactory healing. There is also a definite relationship between such an operation and recovery after the institution of simple drainage, in the event of secondary infection of a mastoid scar.

4. The majority of mastoid antrums are restored in the healing process.

5. Antigermicidal solutions are without demonstrable influence.

6. While wounds heal more satisfactorily when rather thoroughly closed, complete primary closure is unsurgical and unsafe.

7. The results of suction applied to the external auditory canal are uncertain.

8. The "packing" method of dressing simple mastoid wounds, while more certain of thorough and solid healing, prolongs the dressing period and tends toward increased deformities.

9. Wound management providing for constant aeration and drainage shortens the dressing period and tends toward excellent cosmetic results.

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LYMPHO-EPITHELIOMA OF THE TONSIL

A BILATERAL CASE *

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The sensitivity of certain tonsillar tumors to radiation has been recognized for about eight years. In 1921, Regaud described the histopathology of certain peculiarly radiosensitive intra-oral tumors which he called lympho-epitheliome. Two of his co-workers subsequently described the clinical picture.[1] Quick and Cutler,[2] with the able assistance of Ewing, made noteworthy contributions to the knowledge concerning this neoplasm. A recent contribution by Cutler [3] summarizes very well the entire knowledge concerning this pathologic and clinical entity.

The following case [4] is reported to assist in establishing it as a true clinical entity and to show that a normal appearing tonsil may be the site of a neoplasm.

REPORT OF A CASE

E. K., a white woman, aged 60, was well until December, 1925, when she noticed a sense of constriction and discomfort in her throat. Simultaneously a mass appeared at the angle of the jaw on the left side. This mass enlarged to the size of an egg in one month. There was no history of acute intra-oral infection.

Physical examination at the time gave negative results, except for the oral cavity and the neck. The left tonsil was greatly enlarged, red and hard, and the surrounding structures were indurated. The tonsillar crypts were dilated and clearly visible. The right tonsil appeared to be normal. In the left side of the neck there was a mass of glands over the carotid bulb. The Wassermann test of the blood was negative.

Ten steel 10 mg. radium needles were implanted directly into the tonsil under local anesthesia on Jan. 9, 1926, and were permitted to remain in situ for six hours. Radium packs were applied to the neck.

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* From the X-ray Department of the Lancaster General Hospital.

1. Reverchon, L., and Coutard, H.: Lympho-épithéliome de l'hypopharynx traité par la roentgen thérapie, Bull. et mém. Soc. d'oto-rhino-laryngol. Congrès, March 9, 1921.

2. Quick, D., and Cutler, M.: Radiosensitive Type of Intra-Oral Tumor, Surg. Gynec. Obst. **45**:320 (Sept.) 1927; Radiosensitive Intra-Oral Tumors, Brit. J. Radiol. **34**:425 (Dec.) 1927; Radiation Reaction of Metastatic Squamous Cell Carcinoma in Cervical Lymph Nodes, Am. J. Roentgenol. **14**:529, 1925.

3. Cutler, M.: Radiosensitive Intra-Oral Tumors: A Clinical Study, Arch. Surg. **18**:2303 (June) 1929.

4. This case is reported through the courtesy of Dr. W. Hess Lefever.

The patient remained well until Jan. 10, 1928, or almost exactly two years after the radium implantation; then she developed severe headache and diplopia. There was a mass above and mesial to the inner canthus of the left eye (fig. 1), involving the frontal bone and the frontal and ethmoidal sinuses. This mass displaced the left eye laterally. Several days later, dysphagia developed. There was no dyspnea or hoarseness.

Laryngoscopy revealed a mass in the right pharyngeal wall at the pharyngeo-esophageal junction, which was submucosal. There were no palpable cervical glands. A roentgenogram of the chest showed no metastasis.

A series of five roentgen treatments was given to the left frontal area and the left and right cervical areas. The factors were: 140 kilovolts, 5 milliamperes, 40 cm. skin target distance; 10 by 10 cm. areas; 4 mm. aluminum filtration; time, 6 minutes. On the tenth day, the frontal mass had regressed and the dysphagia was greatly relieved.

On Feb. 21, 1928, the patient complained of great dryness of the mouth and partial deafness in the left ear. Examination revealed a mass in the left naso-pharynx occluding the eustachian tube and another tumefaction in the left soft palate. Both of these masses resembled the orbital mass. Digital examination was confirmatory, except that the right tonsil was stony hard, but normal in size and well circumscribed. It did not have the visual appearance of a neoplasm nor was there any ulceration, but the hardness aroused the examiner's suspicion, and a biopsy was taken.

The pathologist's report indicated lympho-epithelioma (fig. 2). Sections were sent to Dr. Ewing, who gave the following confirmatory report:

"This case shows the structure which we are now calling lympho-epithelioma. It is difficult to distinguish many of these cases from lymphosarcoma. The clinical history helps, and here the absence of nodes in the neck after two years is against the diagnosis of lymphosarcoma."

This biopsy was taken from a normal appearing tonsil (the right), the left having been destroyed by radium in 1926.

The recurrences mentioned failed to respond permanently to radium or roentgen therapy, and the patient died on June 30, 1928.

COMMENT

The significant points in the clinical course of this patient are:

Duration	2½ years
Location	Tonsil
Radiation response	Sensitive
Metastatic response	Sensitive
Recurrence	Diffuse, not glandular
Opposite tonsil	Involved

I believe that the most important observation in this case is the positive result of the biopsy from the right tonsil two years after the destruction of the left tonsil by radium. In no previous report of a case was this observation mentioned. The pathologic condition that aroused the examiner's suspicion was the stony hardness of the tonsil. The opposite tonsillar fossa, the original site of the disease, was normal on palpation.

Fig. 1.—Metastasis to the left frontal bone, frontal and ethmoidal sinuses, April 30, 1928.

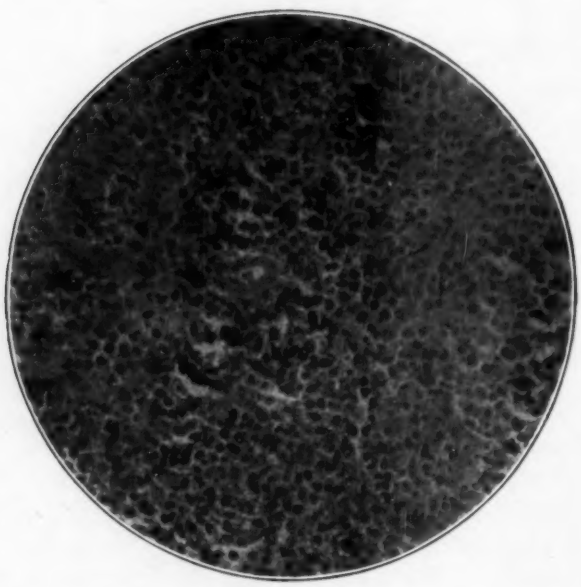

Fig. 2.—Photomicrograph of the right tonsil; × 400.

Bilateral tonsillar involvement by neoplasia is not rare but is usually easily diagnosed by inspection. It is accounted for by the contact of the tonsils during the acts of phonation and deglutition, the tonsil that is first involved implanting it on the second—a so-called "kissing cancer." The presence of carcinoma in an apparently normal tonsil two years after the destruction of the other tonsil raises some interesting problems. So-called silent metastatic areas have been noted before.[5] I am unable to understand the reason for these quiescent areas.

The value of palpation of both tonsils in dealing with intra-oral neoplasia must be stressed. The numerous areas of lymphoid tissue in the nasopharynx afford easy access to neoplastic cells and metastatic growth, visualization of which means relatively little without palpation.

CONCLUSIONS

1. The clinical characteristics of lympho-epithelioma of the tonsil have been reviewed and a case which fulfils these criteria is reported.

2. Metastasis to the remaining tonsil was shown, in which palpation alone revealed the pathologic condition.

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5. Goforth, J. L., and Snoke, P. O.: A Consideration of Body Resistance to Neoplasia, with Report of a Case of Carcinoma of Cervix of Long Duration and with Distant Metastases, Am. J. M. Sc. **175**:504 (April) 1928.

OBSCURE MAXILLARY INFECTION*

W. L. POST, M.D.
JOPLIN, MO.

My purpose is not to discuss maxillary sinus infection in detail but to present a helpful routine for determining its presence and importance.

The positive diagnosis of a maxillary infection frequently is difficult to reach, and the importance of such infection to other disease is difficult to determine.

Experience has shown that no one or two diagnostic procedures can be relied on, especially a single negative washing; nor is any one procedure more important than the other. It is only by viewing the case through all the diagnostic aspects that one can arrive at a true picture, accurate in diagnosis and in prognosis, as to both outcome and most satisfactory method of care, and still avoid overemphasis of the importance of a maxillary infection, coincident, but not directly associated, with some other illness.

I want to stress especially the importance of history, not only from the first statement but from cross-questioning. One must remember that the patients do not have medically trained minds and that details important to the physician, but unimportant to them, may be recalled only on the second or third questioning, either from different angles or in connection with some diagnostic procedure.

Direct inspection of the nasal membranes, the lower turbinate especially, gives many a clew, but an apparently healthy membrane does not preclude infection. Frank pus, of course, immediately stops one's search, but a case with frank pus is hardly an obscure one, and is outside the scope of this discussion. Inspection should always be accompanied by transillumination. I know that this procedure is falling into disuse, but it requires only a few moments and is often of great help. Irrespective of the observations, roentgenograms should be taken. Neither evidence obtained by the roentgen rays nor that obtained by transillumination is in itself conclusive; many an old thickened membrane or bone will be found to show a shadow, apparently conclusive of infection, but further examination will fail to substantiate its presence, and questioning will bring out a history of infection or injury years before. I use the transilluminator for the preliminary examination, then wash the antrums, culture the washing and fill the cavity through the needle with one of the halogenated oils. Whenever possible I introduce the antroscope, but have found its field limited by difficulty of introduction into small nasal passages. When introduction is possible, it is invaluable.

* Submitted for publication, Dec. 18, 1929.

The use of halogenated oils in roentgen examination is indispensable in the determination of the condition of the maxillary mucosa—whether it is thickened uniformly or shows small polypi. This information one must have to make an accurate diagnosis, to determine whether or not operation is necessary and then to help decide whether the inferior meatal or the open transmaxillary route of operation is preferable. This cannot help, however, in cases in which there are no well defined mucosal pathologic changes, or in cases in which some antral infection is recognized but in which its importance in the general picture has to be evaluated.

The presence of free pus in the irrigation is sufficient evidence, but one is not always so fortunate as to find either frank pus or absolutely clear washings. There are a great number of washings that show clear mucous strings or a fine granular and flaky material that cannot be called pus without straining the use of that much abused word. It is this type of washing in which I am interested, and in which I find culturing is a necessity if the physician is to be accurate in his diagnosis. The technic is simple. When the first few drops of antral washing spill over into the nose, the remainder is drawn back into the syringe. This is repeated, a surging current being used in the antrum until 40 or 60 cc. is withdrawn. This fluid is then viewed in a clean centrifuge tube or beaker by a strong transmitted light. (I find that all floating particles show clearly with this method and prefer it over the use of black-bottomed pans.)

All washings should be cultured, and the results secured in the nasal examination should be considered in view of the systemic complaint with its symptoms. I find from experience that perfectly clear washings will give a negative culture in nearly all instances. The number of colonies is a guide to the amount of infection, and in case it is desired, quantitative methods can be used (see case 2).

Briefly, a routine procedure for examination of maxillary sinus infection is outlined: history, inspection, transillumination, roentgen examination (with or without contrast oil) and culture, which permits not only diagnosis but a fairly accurate measure of the importance of such infection. Moreover it gives information vitally important in the choice of a method of treatment or type of operative procedure.

The cases cited are chosen to illustrate the value of culture for the determination of the virulence of bacterial flora.

REPORT OF CASES

CASE 1.—F., aged 36, complained of pronounced weakness and a daily elevation of temperature of from 0.4 to 1 degree. Consultation concerning the condition of the nasal sinuses was asked. Ten years previously, the patient had begun to have frequent colds in the winter, with mucous discharge from the nose. The colds had been practically absent the last three winters, however.

Roentgen examination of the sinus showed sphenoid, ethmoid and frontal sinuses of normal density. The right antrum was clouded, with a slight increase in density of the left.

Culture of the antral washings showed a sparse growth of *Staphylococcus albus* on the two sides, the left side showing the heavier growth.

In view of the history and the type of sparsity of bacterial growth, the physician was advised to search for another focus. This was done, and another focus was found.

CASE 2.—M., aged 16, had had chorea in 1920. The tonsils were partially removed, with remission of chorea until 1926, when it recurred. Remnants of the tonsils were then removed with remission until 1928, when chorea recurred following an attack of acute rhinitis four weeks previously.

The right middle turbinate was dry and over-red. The left middle turbinate was wet. There was a slight thickening in the phenoid region.

The tonsils were removed completely.

Roentgen examination showed frontal, ethmoid and sphenoid sinuses of normal density. The right maxillary sinus showed a slight increase in density. The left maxillary sinus was normal.

There were very few strings of mucus in the maxillary washing.

Culture showed: *Staphylococcus albus* and *aureus* with *Streptococcus hemolyticus.*

Daily lavage of the antrum with 1.5 per cent mercurochrome—220 soluble resulted in a clinical cure of the chorea in two weeks, at which time culture still showed a few colonies of *Streptococcus hemolyticus.*

Treatment was continued until cultures were negative for the streptococcus.

In this case, although the growth was scanty, the presence of the streptococcus made the maxillary the probable source of infection.

CASE 3.—F. was under treatment for gastric ulcer. The patient had a slight cough. Consultation was asked as there was a possibility of a focal infection in the nasal sinuses. There was a history of a slight cough, with a clear nasal discharge for years. The patient had autumnal hay-fever (the examination was made during the early spring).

Examination showed the middle and lower turbinates 25 per cent oversized, wet and boggy on the two sides. The sphenoid region showed only a slight mucosal thickening.

There was interarytenoid irritation of the larynx. The cords moved normally and were free from growth.

The tonsils were removed completely.

Roentgen examination of the sinuses showed normal ethmoid and sphenoid sinuses. Both maxillary regions were slightly dense.

The maxillary washing contained a considerable amount of stringy, clear mucus from the two sides. Cultures were negative. Iodized sesame oil 40 per cent was used, and roentgenograms were taken a second time. Both antrums showed a normal filling. In view of the history of hay-fever, negative cultures and failure to demonstrate a filling defect, a study of sensitization to protein was advised. The bacteriologic study with mapping of the maxillary cavity spoke against infection.

CONGENITAL DEFORMITIES OF THE EXTERNAL EAR

THEIR MENTAL EFFECT *

C. R. STRAATSMA, M.D.
NEW YORK

My endeavor in this paper is to present the common congenital deformities of the external ear and their effect on the mental outlook of the patient.

These deformities vary from complete absence of the ear to the oversized and flopped type. The following cases are examples of the varieties that appear in the plastic clinic of J. Eastman Sheehan.

Figure 1 shows a typical case of microtia. For infants and young children who present deformities of this kind, past experience leads me to recommend only the surgical procedure that aids in normal development, and to defer all major work until the patient is 16 years of age.

Figures 2 and 3 undoubtedly show the effects of undue intra-uterine pressure, because in each instance the head is smaller on the side of the deformity; in one case the arm on that side is underdeveloped. These deformities were dealt with by freeing the attached parts and placing them in their proper relations, skin grafts being used to cover the defects left by their release.

Figures 2*B* and 3*B* show the final results.

Figure 4 demonstrates a dual combination of abnormalities: protrusion and a partial loss of the helix on the right side. Figure 4*B* shows the postoperative results that were obtained by rearranging the cartilaginous framework.

Figures 5 and 6 show patients with large protruding ears.

Figures 5*B* and 6*B* show the same patients after correction, which was accomplished by excision of a portion of skin and cartilage and by resuture.

Though these persons are greatly improved cosmetically, the restoration of their mental outlook on life is a most important factor. In one instance, the patient was a graduate of pedagogy in one of the large universities of the country, but he failed to get a position because

* Submitted for publication, Sept. 26, 1929.

* From the Plastic Clinic of J. Eastman Sheehan, the New York Post-Graduate Medical School and Hospital.

Fig. 1.—Microtia in a young child.

Fig. 2.—*A*, before operation, and *B*, after operation, on a deformity that is the result of undue intra-uterine pressure.

Fig. 3.—*A*, before operation, and *B*, after operation, on same type of deformity shown in figure 2.

Fig. 4.—Front and rear views of patient who showed protrusion and partial loss of helix: *A*, before operation; *B*, after operation.

Fig. 5.—Patient with large protruding ears: *A*, before operation; *B*, after operation.

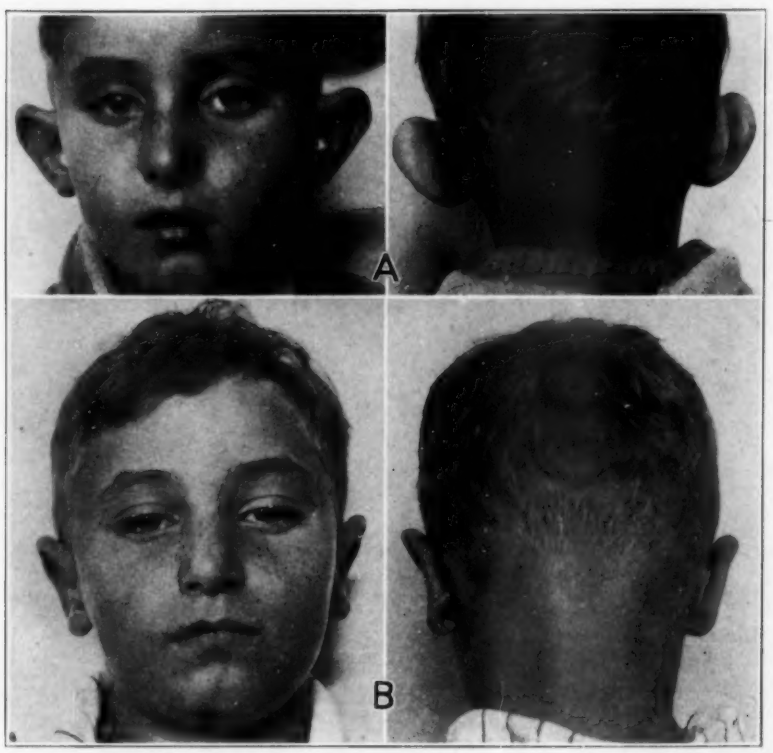


Fig. 6.—*A*, before operation, and *B*, after operation, on patient with large protruding ears.

his appearance indicated a lack of aggressiveness. After correction of his deformity, he had no trouble in securing a school, because it removed not only his physical defect but also his mental handicap, thus enabling him to recover his mental poise.

I conclude, then, that in these persons the inferiority complex brought about by the taunts of playmates and associates is as detrimental to complete development as is the defect itself.

636 Fifth Avenue.

PEANUT IN THE BRONCHUS OF AN INFANT AGED TWENTY-TWO MONTHS

BRONCHOSCOPY WITH RECOVERY *

T. R. GITTINS, M.D.
SIOUX CITY, IOWA

M. E. M., aged 22 months, who was seen on May 15, 1929, choked while eating crackerjack, sixty-five days before. There were coughing and difficult breathing for two hours, and a peculiar rattle in the chest. The child had previously been in good health. Next day, cough and difficult breathing were present, with a temperature of 104 F. A physician was called and he diagnosed the case pneumonia. The child continued to run a high fever with cough and difficult breathing for nine days. There was still a peculiar rattle. The temperature was normal for three days but the wheezing respiration did not clear up. Again the fever returned with an increase in cough, night sweats, loss of weight and poor appetite. The second attack continued for about ten days and was diagnosed as another attack of pneumonia. Again the temperature became practically normal, and remained so for about nine days, but there still were cough, difficult respiration and a peculiar rattle in the breathing. The patient had now lost 10 pounds (4.5 Kg.), was weak, pale, perspired freely and had a poor appetite. During the nine weeks there were three exacerbations of fever with increase in the other symptoms, and a diagnosis of pneumonia was made each time. During the entire course the parents had noticed a peculiar rattle in breathing and mentioned that the child never took a deep breath without coughing and choking. Three or four different doctors saw this patient during this long course and did not advise search for a foreign body. The parents insisted throughout that the entire trouble began when the child choked while eating crackerjack. One doctor advised the parents that if there was a foreign body in the bronchus from the crackerjack it would dissolve. Finally the parents came for possible bronchoscopic examination at the suggestion of the mother of a child that had had a similar experience several years ago. The attending physicians did not advise this consultation.

Examination showed a well developed child, aged 22 months, who looked well nourished, considering the troubles she had had during the previous sixty-three days. She was pale and irritable, and perspired easily. Without a stethoscope a peculiar wheezing respiration could be heard; when the child coughed or cried, a distinct tracheal slap was evident. There were loud musical râles over each side of the chest. There was a slight decrease in expansion of the right side of the chest. Air seemed to be reaching all parts of each lung.

A roentgenogram of the chest showed a dense shadow at the base of the right lung. The upper portion of the right lung was clear; there was general clouding of the entire left lung. The heart was not displaced.

The temperature was 99 F. The red blood cells numbered 4,000,000, and the white blood cells, 18,400.

Bronchoscopy.—Without anesthesia, a no. 5 Jackson bronchoscope was passed. A foreign body was evident just below the opening of the right bronchus. The

* Submitted for publication, Sept. 16, 1929.

patient coughed and the foreign body came into the trachea; immediately it went deep into the bronchus on inspiration. There was a moderate amount of thickening and inflammation of the mucosa at the opening of the right bronchus, but much less than one would expect after the long sojourn of the peanut. The foreign body was grasped and removed together with the bronchoscope because of its size. It proved to be almost half of a peanut which was very firm and appeared more like a piece of raw potato than a peanut. It had no tendency to crush when grasped by the forceps. When removed, it was 8 by 10 mm., but the next day, after drying, it had shrunk in size to 6 by 8 mm. The child was on the table for eight minutes and left the operating room in good condition.

Progress.—The patient improved rapidly. There were coughing and hoarse crying the first day and night but practically no rise in temperature, and the peculiar wheeze and rattle were gone. She remained in the hospital for three days and her condition improved so rapidly that she was allowed to go home. The child has been seen at intervals since and is entirely free from symptoms in the chest; she has gained in weight and strength, and the pediatrician pronounces her condition normal.

COMMENT

1. A peanut was present in the bronchus and trachea of an infant, aged 22 months, for sixty-three days before the diagnosis was made.

2. There was a definite history of choking while eating crackerjack, yet the child was watched through three attacks of so-called pneumonia without a foreign body being considered. Several physicians saw the patient and none advised bronchoscopic examination.

3. Through a peculiar coincidence this patient came to us at the suggestion of the mother of a child who had gone through a similar experience in 1924. This little girl was 5 years of age and had had a peanut in the bronchus for nine weeks before it was removed. We reported this case in the *Laryngoscope,* in August, 1924. Both patients came from the same town in South Dakota, and the latter came at the suggestion of the mother of the former patient.

4. The condition of the child was decidedly better than one would expect after the sojourn of a peanut in the bronchus for sixty-three days. The fact that there was only one foreign body and that this remained intact and was freely movable in the trachea and bronchus probably explains the small amount of trouble in the lung. There had been little obstruction of secretions, and lung tissue was probably not drowned at any time. The lack of reaction in the mucosa of the trachea and bronchi was striking and emphasizes again that peanuts do not always cause the severe local reactions generally attributed to them.

408 Davidson Building.

Clinical Notes

AN UNUSUAL CASE OF FOREIGN BODY RETAINED IN THE MOUTH*

E. Garland Walls, M.D., New Orleans

With the exception of the foreign bodies that lodge in the crypts of the faucial tonsils and intentially concealed foreign bodies, as in the case of thieves or smugglers, foreign bodies retained in the mouth are rare. Occasionally, sharp pieces of bone of fish, fowl or beef penetrate the epithelial lining and remain embedded in the soft tissue for a longer or shorter period of time. The case herein described is unusual for several reasons, the most interesting of which are its unique or at least rare location, surrounding the tongue at the root, and the fact that its whereabouts remained a mystery for seventeen days.

REPORT OF CASE

Helen M., a colored girl, aged 3 years, was admitted to the clinic of the Eye, Ear, Nose and Throat Hospital on Nov. 19, 1929, with a history of having swallowed a "watch ring" two days before. She had been to another clinic on the day of the accident (November 17), and a roentgen examination was made there. The roentgenogram showed the presence of the opaque foreign body in the mouth. A high esophagoscopy and bronchoscopy revealed no visible foreign body in the mouth, esophagus or respiratory tract as far as the primary bronchi. Fluoroscopy showed no foreign body. The patient was therefore discharged, the staff of that clinic believing that she had had the foreign body in her mouth at the time the roentgenogram was taken and that she had removed it herself afterward without the knowledge of attendants. In spite of these observations, the mother said that the physicians had told her that they had seen the ring, and that it had been pushed into the stomach.

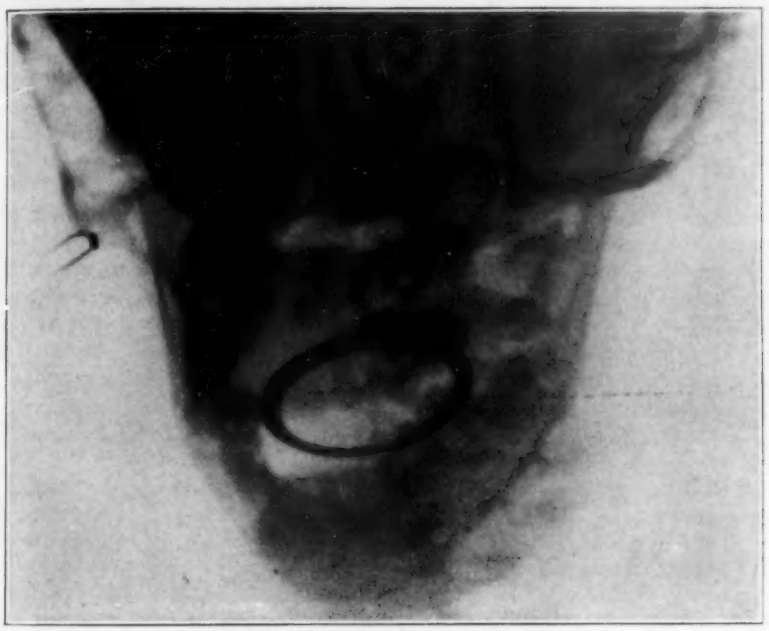
After her discharge from the first institution, the patient was brought to me with dysphagia as the chief symptom. Roentgenograms were taken to show the gastro-intestinal tract in its entirety, but unfortunately, although the plates showed an area as high as the base of the skull and the lower one third of the body of the mandible, the chin was elevated, and the area that should have showed the foreign body was omitted. These plates were considered sufficient in the face of a previous esophagoscopy, the examination by inspection of the pharynx, tonsil region and mouth, and the history given by the mother. The patient was allowed to go home, and an expectorant cough mixture was ordered on account of bronchitis. She continued to do well and reported for observation every four days for two weeks. She seemed to suffer only from a mild respiratory condition, but was not inclined to eat.

* Submitted for publication, March 1, 1930.

* From the Department of Otolaryngology, the Eye, Ear, Nose and Throat Hospital.

On Dec. 5, 1929, the patient showed her mother the metal ring under her tongue, and she was brought to the hospital immediately. By digital examination, the ring could be felt under the tongue, but at no time, even when we knew that the foreign body was in the mouth, could it be seen, as the sharp edges had cut into the tongue and had become buried in the tissue. There was no edema of the tongue. It was impossible to obtain cooperation on the part of the child, so a general anesthetic was given.

The sharp rim of metal was uncovered anteriorly and caught with an artery forceps. It was not until this time that the metal ring was discovered to be not the ring off the watch stem, as described by the mother, but the rim that holds the crystal on an Ingersoll Midget Watch. The tongue had been pushed through the ring. Posteriorly the ring was between the epiglottis and the tongue and had



Roentgenogram taken on Nov. 17, 1929.

cut its way into the tongue substance. The ring was twisted with the artery clamp so that it was raised over the lower teeth on the right. With the index finger of the right hand passed over the dorsum of the tongue, the ring was grasped posteriorly and was easily removed. There was no bleeding or infection, and a rapid recovery followed.

COMMENT

The lesson to be derived from this case is that a complete examination of the mouth should be made in every case when a swallowed or aspirated foreign body is suspected. This should include palpation as well as inspection and should be supplemented by a roentgenogram of the whole skull. It is also important in this connection to avoid being misled by an inaccurate history as I was to a certain extent when the mother said that the ring had been seen and pushed down into the stomach by the first physician.

MIXED TUMOR OF THE PAROTID TYPE GROWING FROM THE POSTERIOR ASPECT OF THE THYROID CARTILAGE

Report of a Case *

R. C. LYNCH, M.D., NEW ORLEANS

I saw the patient for the first time on July 7, 1924. At that time, he was suffering from some dyspnea, hemoptysis, hoarseness and cough. The general history was unimportant, except that symptoms had come on gradually about six months before, and had increased to the present state. Physical and roentgen examinations of the chest gave negative results. The Wassermann reaction was negative, and observations on the blood were normal. The patient had received no injury to account for the symptoms.

On examination, I noticed incomplete fixation of the right vocal cord with a slight lag in motion of the opposite side. The cords were not red or swollen, and the margins were smooth. The false cords and arytenoids were normal. One could see below the cords posteriorly a rounded, smooth mass as if the posterior wall of the larynx and the upper two rings of the trachea were bulging into the larynx, and over the subglottic area posteriorly there were some blood streaks or clots.

With the patient under general anesthesia and in suspension, one saw, by pushing the cords aside, the appearance already described, but more extensive. By palpation, the area was found to be firm, as if the mass was a chondroma.

A thyrotracheotomy was done in order to view the area better; the mass was found to be so firm and adherent that dissection removal seemed impossible.

Accordingly, a portion was removed from the upper tracheal area, and ten needles of 5 mg. of radium each were placed in and around the growth. They were left in for six hours.

A tracheotomy tube was placed at the lower end of the wound, and a tentative diagnosis was made of chondrosarcoma. The trachea was packed and kept open for observation. After a period of seven days, the wound was allowed to heal, and breathing was again resumed through the mouth.

The report of the pathologist was mixed tumor of the parotid type. The patient returned home and seemed apparently well. He was instructed to return if the symptoms returned. He had a good voice, and the cords were functioning.

In March, 1927, he returned with the same symptoms, and this time a tracheotomy was done under local anesthesia. Three days later, with the patient again under general anesthesia and in suspension, a second regrowth was observed, and the thyrotracheotomy wound was reopened.

The tumor extended from behind the thyroid cartilage and was apparently densely adherent to the posterior wall of the trachea, extending down to the fourth ring. At this time two needles of 12.5 mg. each of radium were planted into the growth, and 200 mg. of radium was cross-fired externally, the latter screened with 1 mm. of brass and a finger cot and placed 3½ inches (8.89 cm.) from the skin. The reaction was moderate and was again followed by a retrogression of the tumor mass, but it was necessary to retain the tracheotomy tube for safety.

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* Submitted for publication, Nov. 18, 1929.

* Read at the Twelfth Annual Meeting of the American Bronchoscopic Society, San Francisco, July 6, 1929.

From this time (April, 1927) to February, 1929, the patient was comfortable, talked with a good voice and breathed with a tracheotomy tube. Then he returned again with a tumor, giving about the same symptoms as before. Radium in the same quantity, method and time was used.

On April 18, he returned again with a protruding mass growing from the margin of the tracheotomy tube; it was hard, not vascular, but firmly adherent to its outer wall. The lumen of the trachea was smooth, pink and uninvolved. This mass was removed as completely as possible, which was incompletely, and two needles of 12.5 mg. of radium were put into its base for eight hours. The patient returned home.

The specimen was given to the pathologist, who again reported a mixed tumor of the parotid type.

On June 6, 1929, he returned again with no evidence of tumor externally; the cords were fixed in the midline but would vibrate on talking, which he did well when the tube was closed. There was more encrouchment of a mass on the right beneath the cords and trachea, which felt hard and fixed, and for the first time he had a slight dysphagia. There was still some evidence on the skin surface of the radium application made in April.

The patient has willed his trachea to Dr. Shea of Memphis, through whom this case was referred to me.

It is unusual to see a tumor of this type growing in this location. The tumor and its pathology differ from an adherent thyroid. I report the case because of the rarity of the condition.

MILK OF MAGNESIA AND OLIVE OIL AS A TOPICAL APPLICATION TO MUCOUS MEMBRANES*

ALFRED LEWY, M.D., CHICAGO

Equal parts of milk of magnesia and olive oil have been used by dermatologists for some time for skin irritations, but I have not known of the use of such a solution for acute inflammations of the nasal mucosa. For some months, I have been using this combination with satisfaction to my patients and to myself. There may be added to this base any of the essential oils, singly or in combination as desired. My favorite combinations are 15 or 20 drops of oil of white pine or of eucalyptol to the ounce of the mixture. This solution appears to be quite stable, but requires occasional shaking. It is especially useful when discharges are excoriating. In subacute inflammations of the nasal mucosa, I have used equal parts of compound fluid extract of benzoin, milk of magnesia and olive oil. Such combinations appear to me to be more satisfactory than any silver salts that I have used, but have the disadvantage of not being applicable through the ordinary medicine dropper for home use. For this purpose, I have used a 1 drachm syringe with a large opening and a heavy rubber bulb. It may be that the preparation will work well in a collapsible tube.

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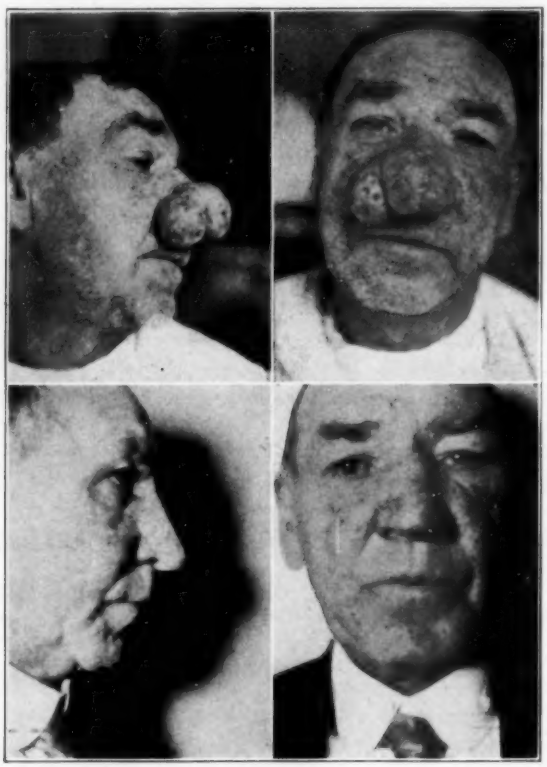
* Submitted for publication, Dec. 10, 1929.

* Read at the Chicago Laryngological and Otological Society, Nov. 4, 1929.

RHINOPHYMA *

SAMUEL SALINGER, M.D., CHICAGO

A patient was operated on for a large rhinophyma. The interesting feature of the case was the unusually large development of the mass, which hung in a lobulated fashion over the tip and the right wing of the nose down to the border of the lip. The result obtained was exceedingly gratifying, particularly in view of the fact that no epithelial grafts were required.



The upper figures show the patient before, and the lower figures after, the operation.

The amount of bleeding at the operation was inordinate and caused considerable difficulty. It was necessary to keep a tight bandage over the nose for three days before the excessive venous hemorrhage could be controlled.

ABSTRACT OF DISCUSSION

DR. BOOT: I suggest the use of the radio knife as a means of controlling the hemorrhage.

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* Submitted for publication, Nov. 21, 1929.

* Read at a meeting of the Chicago Laryngological and Otological Society, Chicago, Oct. 7, 1929.

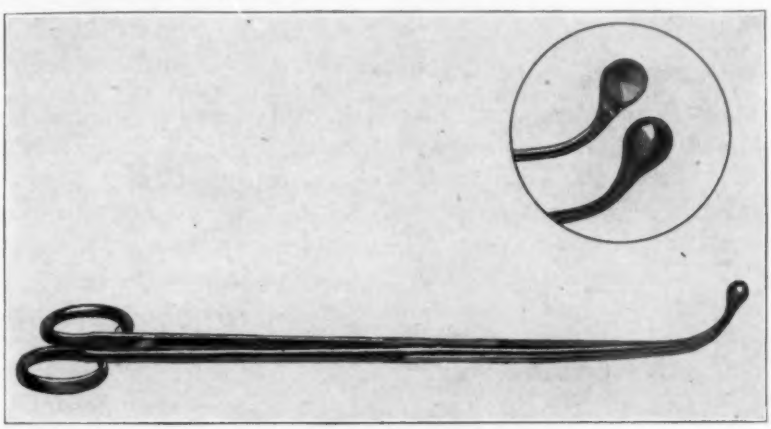
DR. BECK: I recall a similar case in which I operated on the patient at the County Hospital some years ago, which was also characterized by huge pendulous masses. In my case considerable scarring resulted in spite of epithelial grafts.

For the control of venous hemorrhage, I found that the application of the positive galvanic pole was efficacious.

A NEW INSTRUMENT FOR GRASPING TONSIL TABS*

J. COLEMAN SCAL, M.D., NEW YORK

Rhoads and Dick have recorded their observations in routine physical examination of patients on whom tonsillectomy had been done and found that 75 per cent had considerable tonsil tissue left.



The tonsil-grasping forceps.

In the past five years, I have had to do a vast number of secondary tonsillectomies on patients who have been referred to me by their physicians for this purpose. Most of these patients were troubled by tonsil tabs, which had been permitted to remain in situ at the primary operation. These stubs hypertrophy and the focal infection is continued more intensively. This probably explains the continuation of the symptoms after tonsillectomy.

To eliminate this condition I have devised a new tonsil-grasping forceps to facilitate grasping these small tonsil tabs, regardless of their location. When they are held securely by this instrument, they are easily removed by the Eaves snare.

The instrument is simple. It is a modified tonsil forceps, curved at its grasping end so that it can seize the tab, even if the tab extends onto the tongue (lingual tonsil). The grasping end consists of two cuplike blades, which are serrated at their margins and fit accurately into each other.

This instrument is presented in the hope that with its use fewer secondary tonsillectomies will have to be performed.

44 West Seventy-Fourth St., New York City.

* Submitted for publication, Dec. 2, 1929.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

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ANATOMY AND PHYSIOLOGY OF THE EAR

REVIEW OF THE LITERATURE FROM OCTOBER, 1928, TO OCTOBER, 1929 *

PHILIP E. MELTZER, M.D.

BOSTON

ANATOMY

Mouret and Portmann [1] discussed embryologically the temporal bone, and the middle ear and its pneumatic cells. The latter cells are described in detail and are classified in a systematic manner. They also described the infectious paths which are divided in a preformed anatomic and a transosseous path. The interosseous paths are: the external and petrosquamous fissure, the internal petrosquamous fissure, the canalis subacutus and the glaserian fissure. The transosseous paths depend on the structure of the bones which are classified into central cortical, cortical exotemporalis or peripheral. The latter is always thicker than the former. The following forms of mastoiditis are differentiated: retro-auricular, posterosuperior, postero-inferior, mastoiditis of Bezold, jugodigastric, paramastoiditis temporozygomatic superficialis and paramastoiditis-temporozygomatic profundus. In conclusion the authors differ with Wittmach's theory. They believe that the eburnation of the mastoid process is not a result of chronic inflammation, but believe that the nonpneumatization results in individual influences which they call "personal tendency," without recognizing the real cause for the predisposition. If Wittmach's theory were true, a larger percentage of compact mastoid processes would have to be found, since he himself claims 90 per cent of disturbances in the fetus or the new-born, and in the second place, pneumatic processes of the mastoid are frequently encountered in cases in which the patients have suffered from a chronic pyorrhea since early childhood.

Yang [2] made the statement that the mastoid process of the temporal bone as compared with other processes appears of a larger development

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* Submitted for publication, Feb. 17, 1930.

1. Mouret, J., and Portmann, G.: Rev. de laryngol. **49**:555; 595, 1928.

2. Yang, Ho-Ching: Ztschr. f. Hals-, Nasen-u. Ohrenh. **22**:272, 1928.

as a result of its pneumatization and muscle pull. The latter is little considered and generally not recognized in its effect. The author proves this by preparations of temporal bones at the ages of 1 month, 10 months, 1 year, 27 and 75 years and by the attachment of the sternocleidomastoid muscle only to the petrous portion and not to the mastoid process of the squamous portion, as Corner has already shown. The stronger growth of the petrous portion supports the assumption that the muscular pull promotes the growth of the process. On the same preparation the author has demonstrated, by means of the fissure line method, a vertical direction of the fibrils in the corticalis. This corresponds to the result of the pull effect of the sternocleidomastoid, splenius capitis and the longissimus capitis muscles. This agrees with the direction of the bony trabeculi within the inner part of the mastoid process, as the author has seen in his own preparations and as Wittmach's preparations have shown. The author believes that the mastoid process which develops only after birth is adaptable for the proof of the effect of the muscle pull, by its external form. There is formed on the temporal bone in a 1 year old infant a definite visible protuberance on which the attachment of these three muscles could be demonstrated. Finally, the author showed in five cases that in the roentgenograms, in congenital wry neck, the cavities of the mastoid process are more definite on the side on which the sternomastoid is shortened than on the healthy side.

Hesse [3] tried to show the relation between blood groups and pneumatization of the mastoid process. The author divides the pictures of pneumatization in the mastoid process into four groups: (1) the completely pneumatized mastoid in which an extensive cell system with the size of the cells increasing from the center of the periphery extends to the sinus and to the tip of the mastoid process and sometimes also into the squamous portion of the temporal bone and forward to the zygomatic process; (2) the irregular type of pneumatization in which the system may be normal in extent but in which small and large cells are mixed; (3) the small celled mastoid in which the large peripheral cells are completely lacking and all the cells are small; and (4) the completely compact mastoid in which there are no cells and which is seen chiefly in chronic suppuration of the ear. The author gives a table showing the frequency of these different types of pneumatization in the different blood groups as shown by the Berlin and Königsberg figures. He comes to the conclusion that no special type of pneumatization predominates in the different blood groups, and so he thinks there is no special relation between the type of pneumatization and the agglutinizable substances A and B of the red blood corpuscles. The results in blood group IV cannot be considered conclusive because of the small number of patients.

3. Hesse, Walter: Ztschr. f. Laryngol., Rhinol. **17**:240, 1928.

Luscher [4] summarized his investigations with regard to the function of the stapedius muscle as follows: 1. Through a nonstimulating defect of the tympanic membrane in an otherwise normal ear, the tendon of the stapedius muscle may be directly observed under high magnification with an ear microscope. 2. The stapedius muscle of man exhibits regularly and constantly cochlear reflexes that may be incited with almost the same intensity in either ear. 3. In pure tones, the reflex appears only at a definite tone level. This is between 90 and 14,000 oscillations. 4. The tone must have definite intensity depending on the strength. In increased intensity these are at first only slight contractions, which become of longer duration and which cease only with the disappearance of the tone. 5. Noises produce a reflex more easily than pure tones. To cause a contraction it suffices to produce sounds only 50 cm. away from the concha. The reflex appears, therefore, to be adjusted for these stimuli which affect the ear in daily life. It is so sensitive that it must always be active in normal conditions. 6. The reflex appears, therefore, much easier, the stronger, the higher and the noisier the sound effect is. 7. Mere expectation of a strong sound stimulus suffices to produce the reflex; however, the expectation must be in the sense of a conditional reflex, influenced to a certain degree reflexly and cannot be produced simply by voluntary attention. 8. The reflex may also be produced by an inadequate stimulus, i. e., by sticking the ear muscle. 9. Even in the strongest voluntary contraction of the muscles enervated by the facial nerve, there appears to be no involvement of the stapedius. A voluntary contraction of the stapedius was not observed. 10. The contraction of the stapedius appears to be isometric and does not have to follow the movements of the tympanic membrane. 11. All experiments prove that the contraction of the stapedius muscle causes a decrease of the sound conduction and thereby a decrease of the ability to hear. On this basis it is looked on not as a muscle of "attention" but as a protective adjustment which has the purpose to protect in a reflex automatic manner the sound perceptive apparatus from too strong effect, and thus from associated injuries. The corresponding results of Kato on animals were confirmed in every respect by the investigations carried out also for the auditory organs in man.

Mosso [5] observed a distinctly decreased excitability of the vestibule in all patients who had attempted to alleviate their pains by instillation of cocaine, opium preparations, etc., into the external auditory canal. As these observations were noted in the case of patients with fully intact tympanic membrane, and were confirmed by means of experiments made

4. Luscher, E.: Ztschr. f. Hals-, Nasen-u. Ohrenh. **33**:105, 1929.

5. Mosso, F. E.: Atti d. clin. oto-rino-laringoiat. d. r. Univ. di Roma **26**: 45, 1928; abstr., Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:506, 1929.

by the author himself, the conclusion had to be drawn that the tympanic membrane possesses resorption capacity.

In order to demonstrate this conclusively, one auditory canal of twenty persons with an absolutely healthy tympanic membrane was filled with potassium iodide solution. After this, the saliva was tested for iodine every ten minutes. The solution was removed from the auditory canal as soon as the iodine reaction was positive.

In this manner the author succeeded in demonstrating the resorption of potassium iodide by the tympanic membrane and passing of the salt into the saliva of eighteen of the twenty subjects.

The entrance of the potassium iodide into the oral cavity makes itself known by a peculiar metallic taste which is generally reported by the subject spontaneously.

In none of the cases was it possible to demonstrate iodine in the urine. It must therefore be assumed that the iodide passes over into the lymph channels of the tympanic membrane and of the tympanic cavity which are intimately connected with the lymphatic system of the salivary glands. Meurman [6] found by experimental examinations on rabbits that the subarachnoid space communicates freely with the perilymphatic spaces of the internal ear through the aqueductus cochlea. These experiments were supplemented by histologic examinations of material from human beings on the volume and structure of the aqueduct.

In the discussion, Voss said that from his many examinations of the petrous bone of infants and the fact that he frequently found blood in the aqueductus cochleae in birth trauma he thinks he can confirm the author's observation that the aqueduct is open.

Karbowski's [7] experiments were made on dogs and rabbits. They showed that in the rabbit a stain (gelatin solution stained with carmine) passes from the subarachnoid space into the cochlea and from there into the sinuses of the scala tympani. Studies made on the cadavers of newborn infants using the same technic did not show any communication.

Sandison [8] reported his observations on the contraction of blood vessels as seen in the transparent chamber introduced in the rabbit's ear. 1. The endothelial cells of the capillaries exhibit only a limited amount of contractility and play no essential part in the control of blood flow. 2. The adventitial (Rouget) cells are completely inert so far as capillary contraction is concerned. 3. The contraction of the smooth muscle cell on arteriole and artery is almost solely responsible for the regulation of flow through the capillaries.

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6. Meurman: Internat. Zentralbl. f. Ohrenh. **30**:283, 1929.
7. Karbowski: Rev. de laryngol. **49**:662, 1928.
8. Sandison, J. C.: Anat. Rec. **42**:62, 1929.

These conclusions were reached as a result of prolonged studies of vessels under normal conditions, and of vessels subjected to heat and cold and to the action of epinephrine and histamine.

Burlet [9] studied the innervation of the labyrinth of vertebrates and found that the auditory nerve divides as a rule into an anterior and posterior branch, each of which has a foramen in the labyrinthian capsule. The anterior ramus supplies the macula utriculi, crista anterior and horizontal; the ramus posterior supplies the crista posterior and, when present, the maculae lagenae, papilla basilaris (cortical organs), papilla amphibiorum and pappile neglecta. The maculi sacculi is supplied by either the anterior or the posterior ramus, or sometimes by both; frequently these nerve fibers pass through a special opening or foramen in the ear capsule. The occurrence of the branching of the nerves takes place in the following manner: the primitive auditory vesicle has an individual sensory nerve position to which the acoustic nerve extends. The first division leads to the formation of two end-organs, and to a corresponding splitting of the auditory nerve into posterior and anterior branches. The further differentiation of the anterior end-organ leads to a division of the anterior ramus, etc. In general it may be stated the further centrally a point of separation of the nerve is located, the sooner the end-organ belonging to it becomes independent. The maculi sacculi consists of the most anterior part of the posterior organ. On its latter topography depends whether the supplying fibers would be a part of the ramus anterior or the ramus posterior.

Variations of this condition are shown by the author as examples in illustrations. In mammals as well as in other vertebrates the dorsal portion of the anterior widened part of the macula sacculi is supplied by the ramus utricularis. This, however, does not influence the function. Such associations in the nerve supply are found not only in the utricle and sacculus but also in other embryonic end-organs.

Guild [10] described the utriculosaccular communication and the endolymphatic duct origin in a guinea-pig weighing 175 Gm. A model from good serial sections shows that from the lower part of the posterior border of the sacculus a tubelike process, compressed mediolaterally, extends caudalward upward and somewhat laterally 0.96 mm. before entering the aqueductus vestibuli. The proximal half is of uniform caliber; 0.25 mm. from its origin the greatest diameters are 0.27 and 0.12 mm.; the distal half is dilated to a maximal vertical diameter of 0.4 mm. but is more flattened. Posteriorly this dilatation narrows rapidly into the ductus endolymphaticus proprius. The canalis utriculosaccularis has a length of 0.3 mm., a greatest diameter in its narrow

9. Burlet, H. M.: Nederl. Tidjschr. v. Verlosk. en Gynaec. **1**:409, 1929.
10. Guild, Stacy R.: Anat. Rec. **42**:18, 1929.

portion of 0.06 mm. and a cross-section area approximately one twentieth of the saccular extension, and opens at almost right angles into the latter on the upper part of its lateral surface 0.45 mm. from the beginning of the ductus endolymphaticus proprius.

The term sinus posterior sacculi is proposed for the entire tubelike process. For the guinea-pig at least all of the morphologic facts of form, relations and wall structure are better described by this term than those used by any of the three (Boettcher, Hasse, Retzius) whose interpretations have most affected the prevalent conception of this region in mammals, and none of the general principles of terminology are violated. Thus considered, the utriculosaccular communication in mammals opens directly into the sacculus near the endolymphatic duct orifice, as in lower vertebrates.

Guild [11] described a case of bilateral scala communis cochleae uncomplicated by other defects and gave an embryologic interpretation of this and associated anomalies. Absence of the osseous septum in the cochlea between the middle and the apical turns has been previously recorded in at least a dozen cases in man and in two in dogs, always associated with other serious defects such as absence of the apical portion of the modiolus, hypoplasias of the ductus cochlearis and organ of Corti, partial or complete absence of nerves, etc. In the author's collection both cochleae of a child 7 months old showed partial absence of this septum without other abnormalities. Rather more than a half turn of the apical end of the septum was completely absent in the left cochlea; this part was present in the right, but there was a partial defect in the septum between the lower half of the middle turn and the apical.

Resorption of the mesodermal tissues beyond the normal limits during the stage of cavity formation of the scalae tympani and vestibuli with complete disappearance of portions of the connective tissues usually present when ossification begins is advanced as a more plausible explanation than is a primary failure of osteoblastic activity. Thus, in part at least, the simpler forms of this group of anomalies are regarded as the results of a normal phase of mesodermal development proceeding beyond its usual limits (overdifferentiation) rather than as arrests of development. Primary ectodermal deficiencies undoubtedly are sometimes closely associated.

HISTOLOGY

Bast,[12] who has been studying the osteogenesis of the periotic capsule in man for several years, summarized his more recent work as follows:

1. The bone of the periotic capsule is of three types: (*a*) perichondrial bone, (*b*) endochondral bone and (*c*) intrachondral bone or bone formed within the lacunae of the calcified cartilage matrix which persists.

11. Guild, Stacy R.: Anat. Rec. **42**:19, 1929.

12. Bast, Theodore: Laryngoscope **38**:665, 1928.

2. The process of ossification of the cartilaginous capsule begins by (*a*) enlargement of the cartilage lacunae, (*b*) modified staining reaction of the cartilage matrix, (*c*) entrance of connective tissue cells into the enlarged lacunae which replace the cartilage cells, (*d*) entrance of vascular osteogenetic buds which excavate large channels in this changed cartilage, (*e*) primary endochondral bone is formed in the excavated parts, (*f*) the islands change into bone cells surrounding themselves with bone, and (*g*) perichondrial bone is formed around the original cartilaginous capsule.

3. At the junction of the vestibule with the scala vestibuli there is an outpouching of the vestibule which is filled with perilymphatic tissue. This tissue extends from the vestibule to the middle ear. With age this tissue becomes denser. Around it cartilaginous capsule persists even into adult life. This area is variously known as "fissula ante fenestram" ("Siebenmann) or "Cossolino's zone" (perossi).

4. In a small percentage of fetuses a similar outpouching of the vestibule was seen just posterolateral to the oval window. This evagination ended blindly in the bony capsule where it became continuous with the bone-marrow. This structure is known as "canalis membranaceus caecus" (Ibsen) or as "fossula post fenestram" (Siebenmann).

Werner [13] described the structure of the sensory terminals in the labyrinth. In spite of the amount of literature, there is little known about the sensory terminals of the labyrinth, for the majority of investigators have concentrated their efforts on man and some mammals, and have considered other types of animals as nonessential. Fish, especially, offer numerous examples and present an entire new field which could be shown by microphotography. It is also necessary to expand the nomenclature. The essential parts of a macular organ are: the sensory epithelium, (macula) with the otolith membrane (macularium) and the marginal epithelium with the marginal fibers (marginarium), their existence having been mostly denied up to the present. The macularium is tubular in shape and is associated with the sensory hair; the marginarium is cylindrical and arises from the marginal cells. Both are to be definitely differentiated. Many otoliths exhibit a corresponding composition. The sensory terminals are so similar to each other that the expression sensula is introduced for the macula, crista and papilla. The relation of the otoliths to the macula is different from that in mammals, for the otolith is a rigid, coherent body. Six possibilities or degrees of relation may be differentiated: 1. The otolith projects beyond the margins of the macula. 2. The macula as well as the macularium is not covered by the otoliths. 3. It is roofed by it but not in contact with it.

13. Werner: Ztschr. f. Laryngol., Rhinol. **17**:5, 1929; abstr., Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:301, 1929.

4. It is densely covered but definitely separated. 5. The macularium is tangential to the otoliths. 6. The macularium extends deep within. The maculae differ so considerably from each other that one must also assume a different function. Each macula exhibts a pronounced regional variation to the external outline, position in space, height of epithelium, innervation and structure of the otoliths. In this respect the macula sacculi and lagenae are divided in an interior and posterior part, while the macula utriculi contains a semicircular marginal zone, a flattened surface and a dorsally directed tip.

Werner [14] presented numerous illustrations of the anatomy of otoliths in various types of fish. Special attention was paid to the position of the otoliths and to the membraneous pockets and their attachment as well as to the extension and shape of the sensory epithelium. The form and attachment of the otoliths as well as the formation and position of the sensory epithelium differs for various types of fish. It was attempted to explain experimentally the function of the otoliths according to their morphologic relation. The author denies the theory of gliding, the pressure theory and traction theory of the otolith function and presents a new hypothesis. The otolith produces by its weight a difference in hydrostatic pressure in the labyrinthian cavity and the otolith membrane. The details which are here described hold good not only for fish, but for mammals as well.

Steinhausen,[15] by means of an extremely delicate technic, succeeded in making the movements of the cupula visible on fresh living specimens of the pike so that on moving them, movements of the fluid could be observed. He demonstrated photograms of fresh and fixed cupulas which are reproduced in *Zeitschrift für Larynologie, Rhinologie und ihre Genzgebiete,* (vol. 17, nos. 5 and 6).

Přecechtěl [16] reported on the physiologic and clinical importance of pathologicohistologic changes in the inner ear and central nervous system in the new-born with abnormal fetal position. In examination of six cases with abnormal fetal position there were five cases with histologic changes; in two cases the changes were in the inner ear and in the central nervous system and in one case only in the central nervous system. In two cases with the changes in the inner ear and in one case without such changes the central nervous system was not examined. The peripheral changes consisted in severe hypotonic degeneration of the neuro-epithelium of the cochlea and the vestibular apparatus. In one case there was beside that a severe disturbance in development of the

14. Werner, F. C.: Ztschr. f. wissensch. Zool. **131**:502, 1928; abstr., Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:669, 1929.

15. Steinhausen: Internat. Zentralbl. f. Ohrenh. **30**:283, 1929.

16. Přecechtěl, A.: Časop. lék. česk. **68**:149, 1929.

inner and middle ear; these changes may affect one or both sides. The central changes involved the medulla oblongata, the midbrain and partly the hemispheres, in most cases also the cerebellum and in some, only the cerebellum. In the latter the changes were of various degrees but always involved the lingula. These observations may form the anatomicopathologic basis of the clinical syndromes already described by the author (pathologic position of the fetus combined with late sitting up or walking), for they affect the parts of the body which regulate the statics of the organism. By the changes in the inner ear one may also explain the paradoxic reaction which accompanies the syndrone (positive reaction in rotation and negative in calorization). The stimulation in rotation is much stronger than in calorization; the sudden impact in hindering of movement in rotation may produce in the involved cupola or in the crista lacking hair, a reaction which the fine disturbance produced in calorization is not able to produce. The observations may also explain the existence of two forms of speech disturbance which accompany the foregoing syndrome, and to which Seeman has called attention. The disturbances in speech are, on the one hand, a result of difficulty in hearing and, on the other, a result of idiopathic dumbness (without deafness), the latter of which Seeman ascribed to the disturbances in function of the cerebellum. The disturbances in speech as a result of difficulty in hearing may be explained by the peripheral disturbances. The mentioned changes in the cerebellum may serve as a basis for the Seeman theory in the significance of the cerebellum of the origin of idiopathic dumbness. A special significance may be definitely ascribed to the changes in the lingula which were present in all cases; Bender has recently shown that the lingula has some relation to the movements of the larynx.

Buccelli [17] investigated the border between the epithelium and connective tissue of the tunica propria, the glands, as well as the epithelial covering of the eustachian tubes. The results of the investigation are so detailed that a short abstract cannot be given.

COMPARATIVE ANATOMY AND PHYSIOLOGY

De Burlet [18] made a comparative study of the anatomy and physiology of the sensory endings of the perilymphatic space of vertebrates. He divided them into two groups. To the first group belong the three crista ampullare, the utricule, the macula lagenae, and the sacculus and the papilla neglecta. They react to the movement or change of position of the labyrinth. To the second group belong: the papilla amphiborium,

17. Buccelli, A.: Atti d. clin. oto-rino-laringoiat. d. r. Univ. di Roma **26**:481, 1928.

18. De Burlet, H. M.: Acta oto-laryng. **13**:153, 1929.

the papilla basilaris (Corti's organ) the macula sacculi. The terminal organs of the second group react also in stationary labyrinth. A part of the perilymphatic space is thus formed into a conducting system which leads from the capsular wall to the end-organ. The sensory organs of the first group are always present in the labyrinth, but are not always present simultaneously. The sensory organs of the second group are found in certain fishes, and in all terrestrial vertebrates. Correspondingly, one finds in all these forms a differentiation of the perilymphatic space which makes possible the function of the sensory organ in question. This differentiation consists in the formation of a channel filled with fluid which is formed by the local disappearance of connective tissue trabeculi.

In the amphibians one frequently encounters one and sometimes two sensory terminals which are supplied by the ductus perilymphaticus. In sauropsids and mammals there is always only one sensory terminal. In the reptiles this exhibits a considerable variation in the structure, being variable in the crocodiles in which it assumes considerable dimensions. Corresponding to the dimension of the sensory terminals there is also the formation of the perilymphatic system which occupies in the mammals the entire pars inferior of the labyrinth. Of the higher vertebrates, the mammals and birds, it is known with certainty that the perilymph sound waves are conducted to the end-organ in question, which is there perceived. This activity must be ascribed to the perilymphatic conduction system and to the sensory organs belonging to it in all other vertebrates. This conclusion is also justified for various reptiles and some fish. There exists also definite proof that the amphibians, with the exception of frogs, react to sound waves, and it is a question whether the papilla amphibiorum is adapted to a similar reception. It is difficult to determine whether in all terrestrial vertebrates the sacculus takes part in the reception of sound waves. The close relationship between the sacculus and the cysterna perilymphatica is alike in all representatives, with the exception of some reptiles, i. e., the foot of the stapes is always lateral to the wall of the sacculus. The structure of the macula—the nature of its various coverings—does not favor the assumption that this sensory terminal could have a function different from that of the macula utriculi of a similar structure.

De Burlet,[19] continuing his comparative studies, made the statement that among the siluroides there are a number of forms which could produce as well as perceive sounds. In the reception of sounds, the following organs or part of important organs take part: the membrane which separates the surrounding water from the air bladder and which consists of external skin and the wall of the air bladder; the air in the

19. De Burlet, H. M.: Ztschr. f. d. ges. Anat. **89**:11, 1929.

air bladder; the Weber ossicles; the perilymph in the sinus impar; the endolymph and the transverse communicating canal and the anterior segment of the sacculus; the anterior part of the otoliths of the sacculus which is specialized for a reception apparatus, and the anterior segment of the maculus sacculi supplied by its own nerve.

From these one may still further differentiate the existence of a specialized covering in fishes which is similar to the membrana tectoria of the mammalian cochlea which transmits the sound waves.

It should be mentioned that the discoverer of the named chains of ossicles has also presented a theory of their function. Weber called them by the name of auditory ossicles of the middle ear of mammals, and he believed that they conduct sound waves from the superficial surface of the body (skin) to the labyrinth. A series of investigations appear to support the original view of Weber.

Baecker [20] studied the comparative anatomic variations of the ear cartilage in mammals, by means of which he determined the effect of the various mechanical relationships on the finer structure of the ear cartilage. The multiplicity of this fine structure is explained by the fact that the recent idea acquired with regard to the ear cartilage is to ascribe its origin to the local functional requirements. In the auricle of mammals there is present fatty, cellular, elastic and some hyaline cartilage. All these types of tissues are united with each other by transitional forms. Variations exist not only within the same species but also within the same type of animal. Frequently the cartilage of the ear exhibits a certain type of primitiveness (binuclear cells, weak staining of the protoplasm of the cells and lack of retractility). Bone formation in elastic cartilage was demonstrated in a guinea-pig at the distal end of the ear, and an extensive calcification was found in the cartilage of the auditory canal of a mole. In five injuries of the pinna, four showed definite signs of healing partly with new formation of cartilaginous tissue. In the inter-relation between the size, firmness and form, i. e., elasticity of the pinna on the one hand and the structure of its cartilaginous tissue on the other, may be determined so far as the cartilaginous plate consists of firm but easily deformed pinna of small mammals, i. e., fatty cartilage or cellular cartilage poor in ground substance and that of the firm and at the same time tough and massive ear of the hoofed animal consisting of typical elastic cartilage with coarse elastic substances, while the suspended ear of the Indian elephant becomes stiffened by hyaline cartilage. An intermediate position is assumed by the cellular cartilage, rich in ground substance, in the ear of *Megalochiroptera* and larger *Insectivora*, rodents and *Carnivora*, which

20. Baecker, R.: Ztschr. mikrosk.-anat. Forschg. **15**:274, 1928; abstr., Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:658, 1929.

also contain elastic substance in variable amounts. The special flexibility of some ears (those of terriers and rabbits) appears to depend on the fact that the relatively thin wall cells are deposited in a relatively weakly developed interstitial tissue, the elasticity of which depends mainly on the elastic fibers located in the structures. There further exists a certain relationship between the size of the animal and the structure of the cartilage of the ear: fatty cartilage and cellular cartilage poor in ground substances are to be found only in small animals, while cellular cartilage rich in ground substance is found in the medium-sized animals, while the real elastic cartilage is characteristic of the large domestic animal.

Hazama [21] studied the secreting cells of the vertebrate labyrinth. This is a detailed discussion illustrated by photomicrographs of a number of types of vertebrate labyrinths. In the cyclostomes a true secretory region like that of the rest of the vertebrates is not yet developed. In the selaceans there is a series of details in the cells of different regions that indicate that secretion is taking place.

The teleosts show an advanced development of the secretory cells. Here too there seems to be differences in different species due to the varying forms of the labyrinth in various species of teleosts; in some the utricle is the chief structure of the labyrinth, in some the saccule; in some there is only a rudimentary duct and endolymphatic saccule; in some it is lacking entirely, and in some it is well developed. In many teleosts the connection between the utricle and saccule is lost, so that the superior and inferior parts must be independent so far as secretion of endolymph is concerned. In many forms of teleosts the endolymphatic duct is rudimentary and the endolymphatic sac may be lacking and in some cases the sac too; migration of the fluid to these parts of the labyrinth cannot be assumed so the secretory process must be slow.

In the amphibians the cell type of secretory region is the kind usually seen in fishes. In spite of the fact that the cell details can be more easily observed in this class, it was not possible to show accurately the whole process of secretion. The urodeles show a good development of the endolymphatic duct and sac, but this part of the labyrinth is still more highly developed in the anurans. The reptiles show tolerably greater variety in the development of the secretory region and of the labyrinth in general. They are the first to show an intimate relation of the blood vessel to a part of the secreting epithelium.

In the lowest form of mammal available, *Proechidna,* the author found that the labyrinth resembled that of birds in the shortness of the cochlear duct but that of the higher mammals in the development of the papilla basilaris. In the development of mammals, even in the

21. Hazama: Ztschr. f. d. ges. Anat. **88**:223, 1929.

monotremes, there is a completely developed stria vascularis and no suggestion of the tegmentum vasculosum of the reptiles. The type of labyrinth of the monotremes seems to be more like that of reptiles than that of the birds. In the types in which there is a secretory region the distended type of cell filled with granules can no longer be found. In the ascending scale of mammals the stria vascularis becomes more and more prominent. In some types there is a distinct secretory region in the vestibular section. This change is most highly developed in monkeys and man, and in the latter it can hardly be said that there is a secretory region aside from the stria vascularis. As the stria vascularis develops, it seems to take precedence over the other regions, so that fluid is excreted chiefly from it, which moves slowly toward the endolymphatic duct. If the experimental examinations of Guild are conclusive, apparently the wall of the labyrinth is general and the secretory epithelium is not permeable to foreign substances, as shown by experiments with vital stains; like the choroid plexus, it does not seem to be permeable even to acid substances. Von Lennep says that the degeneration of the labyrinth of the dancing mouse begins with a change in the stria.

PHYSIOLOGY OF COCHLEA

Leiri [22] disagreed with the resonance theory and developed a theory of audition of his own. He repeatedly discussed the well known physical basis which speaks against it with regard to the fact that the radial fibers of the basilar membrane may produce in the resonators a tone of ten to eleven octaves and that certain definite fibrils have their own period in the low tones. The contradictions resulting from the slight length variations of the radial fibers can, according to the author's view, not be satisfactorily refuted by the indications of variation in tension and strain. The author believes that the tone perception produces vibratory movements in the stapes which in turn cause a perilymph impact along the scala vestibuli up to the apex of the cochlea, this in its turn producing a wavelike advancing movement of the contents of the ductus cochlearis. The most important rôle for the further conduction of stimuli to the sensory cells, the author ascribed not to the endolymph or basilar membrane but to the membrana tectoria. In order to obtain the oscillation of the membrana tectoria, experiments were made for the study of its mechanical properties (elasticity and internal friction) with the result that a considerable amount of dullness (slow resonance) has been ascribed to it. The molecular wavelike movements on the membrana tectoria are carried out by the hair cells. The author assumes that the hair cells are not capable on the basis of physical resonance to transmit the obtained rhythmic movements into nerve

22. Leiri, F.: Finska läk.-sällsk. handl. **70**:921, 1928.

inpulses, but do so on a biologic basis. The author could easily explain why a tone of which only two oscillations reach the ear, could already be recognized with regard to its scale, while the resonance theory must introduce a high resonance acuity, which is not uniform with strong dulness of the ear resonators. The observations first made by Wein were that the sensitiveness of the ear is maximal in the four octaves, and that depending on the low as well as the high tones, it decreases; according to the author, the explanation is that the perception modus assumed by him reaches the region of the ear only for the eight lower octaves, so that the sensory cells corresponding to the lower tones are located in the apical spirals, while the most anterior basal sensory cells correspond not to the seventh scale but to the fourth scale octave. For the ultramusical tone, no longer associated with the level of tones of variable sensation, is assumed a perception modus. The enormous difference between the threshold energy for the low tones and those of the fourth scale octave is explained by the fact that the sound waves corresponding to the latter take the shortest path to the sensory cells, while the waves of lower frequency, in their passing through the membrana tectoria to the apex of the cochlea are considerably dulled. The observations made by Meyer, but not quantitatively, on dulling of the weaker higher tones by the stronger lower tones are explained by the fact that through the very strong low tones the sensory hairs corresponding to the higher tones are placed in such a strong movement that a weak adequate stimulus in the form of a higher tone cannot penetrate. The explanation given by the author for the secondary sound phenomena could not be discussed here. The perception of the highest tones is explained by the author, through the basilar membrane, in a similar manner as the resonance theory for the tone perception of tone in general; besides, the basilar membrane makes also possible the perception of noises. Weak noises cannot be in resonance with the tense portion of the tympanic membrane because of its continuous variation in frequency and amplitude, and they take their course along the pars placcida to the middle ear advancing partly by the bone conduction, especially by conduction of the relaxed membrane of the fenestra rotundum up to the scala tympani, from where they follow along the tympanic layer and influence the fibers of the basilar membrane. Since the radial fibers of the basilar membrane do not oscillate individually but in unison with each other, according to the author, the noise with its variable period stimulates a number of adjacent radial fibers in a certain area; the author therefore assumes in the basilar membrane definite radial fibers for the perception of ultramusical tones which occupy the entire basilar spiral and work according to the resonance principle. In the second place, the basilar membrane contains fibers for the perception

of oscillations (not tones) of a lower frequency which enter the inner ear as components of noises. These fibers do not work according to the principle of resonance. By the intervention of the basilar membrane, the sensory cells could then be stimulated only through the rod of Corti when the membrane oscillates in its greatest circumference. The lowest frequencies present in noises, according to the author, exist, as a rule, only in strong intensities, are not transmitted by the basilar membrane but are capable of stimulating the membrana tectoria throughout its length even though they compromise only one oscillation. The assumption of the two different perception moduses for sounds and noises is advanced by the author in the light of clinical facts. The quantitative bone conduction tests by Weber and Schwabach are explained as follows: In healthy persons in closure of an ear, the perception is suppressed for this ear in usual surroundings in spite of the presence of noises; therefore its hearing threshold is reduced, and a tone from the skull is therefore better perceived with this ear. In the conduction of persons hard of hearing, the tone conduction and the noise conduction may suffer, so that such an ear could likewise hear better a tone along the bone conduction. That the normal hearing threshold could be diminished by suppression of the advancing noise perception is proved by the "silent camera" of Zwaardmaker.

Bonain [23] denied the theory of conduction of sounds of the inner ear, according to which the vestibular apparatus plays a rôle in the audition. The conduction through the tympanic membrane, the auditory ossicles, the fenestra ovale and the vestibulus is not acceptable for two reasons: 1. There is found, in the first place, sufficient or even abnormal hearing ability in spite of the immobility of the ear ossicles, in spite of the injury to the tympanic membrane or to the ossicles, as well as loss of function of the fenestra ovale. 2. The intactness of the vestibular apparatus, i. e., the sacculus, utriculus and the ampullae of the semicircular canals in injuries to the ear with regard to the perception of sound. The analysis, according to the view of some authors, takes place within the ear itself, while according to others it takes place in the brain. The author represents the view that just as for exact vision the eye is necessary, so also for definite and exact hearing the ear is necessary, in other words, that organ which makes possible the analysis of the sound. The dissociation of the complex acoustic waves takes place, according to Bonain's view, by a lateral cellular effect of the cells of Corti in the space enclosed by rods. The sounds are conducted as continuous wave motions to the ear and reach the scala tympani of the cochlea by a most direct path, namely, through the posterior recess of the tympanic cavity

23. Bonain: Ann. d. mal. de l'oreille du larynx **48**:335, 1929; abstr., Ztschr. f. Hals-, Nasen- u. Ohrenh. **13**:737, 1929.

and the fenestra rotundum. The membrana tectoria which is associated with the hair cells is placed in motion in its individual parts by existing waves.

Bekesy,[24] studying the various theories of audition, remarked that their essential differences could be ascribed to the magnitude of the mechanical properties of the basilar membrane (elasticity and friction): In order to obtain the form of oscillation in the basilar membrane and thereby satisfy one theory, it is necessary to prepare an ear model; because of the small measurements of the cochlea, the model must be enlarged four or five times. How the imitation and the enlargement could be obtained without changing the movement phenomena of the model has been discussed considerably. The details of this carefully studied question must be read in the original; nevertheless, I wish to characterize here the method of work. The author went so far as to determine in minute experiments the friction coefficient of the endolymph, and the elasticity of the model membrane was adjusted to that of the basilar membrane. For this purpose, experimentally affecting sounds were introduced to the model, which showed that by a sufficiently thick membrane the sound stimulation may lead to an exact localization of the perforation of the membrane, the point of localization being changed by a constant stimulation frequency with a decreased thickness of the membrane. The membrane thickness was so selected that in stimulation with a definite frequency the perforation resulted in a point corresponding to the natural ear. The oscillation form of such a prepared membrane, which corresponded, so to speak, to aperiodic co-oscillation of the resonators, appeared therefore in opposition to numerous measurements on the diminished resonance of the ear resonators which could be checked. In criticizing earlier experiments, personal experiments were carried out which attempted to determine the period of oscillation of the ear resonator according to echo method of Hartridge as well as by the method of interrupted rate of Helmholtz (a detailed explanation of the observations is to be found in the original). In addition, the author also pointed to the phenomena of tone silencing studied by Wegel and Lane as well as to the measurements of subjective changes in the sounds of the two sympathetic tones, as shown by Barkhausen and Lewiki, the frequency of which would gradually approach each other. Both methods lead to not fully theoretically substantiated conclusions concerning the diminished resonance of the ear resonator. The results of these tests may be summarized by the statement that the facts known up to the present speak not against, but even for, an aperiodic decrease of resonance of the ear resonators. Further, the author studied the importance of the contrast of the hearing to the optic theory, as shown by Mach. Besides the membrane movements, the

24. Bekesy, G. V.: Physik. Ztschr. **29**:793, 1928.

surrounding fluid was also studied on the model, and for this purpose he suspended charcoal particles, and for the photography, fine granulated metal. By a sound stimulus there developed an advancing wave in the direction of the helicotrema, which was so dull that no movement resulted along the helicotrema. In a definite point there formed above and below the membrane a definite whirl the localization of which depended on the frequency and velocity of the amplitude of the exciting tone. The whirl was located in a low frequency near the helicotrema and in a high frequency near the cupola. The formation of the whirl is explained by simple mechanical laws; the immediate observations were carried out by means of the microscope. Similar observations were made on another model on which, besides the basillar membrane, Reissner's membrane, as well as the ductus cochlearis, was formed. When the fluid movements observed in the model correspond actually to a similar endolymph current in the ear, according to present knowledge, there must result from the vestibular reflex, by the production of a loud tone, a movement of the head, and in the removal of the head, a movement of the fluid in the opposite side. Both reflex movements were confirmed in the experiment. Finally, the oscillating basilar membrane was confirmed by direct observation; the movements result in the form of an advancing wave and not as a stationary wave. For this purpose fresh petrous bones skilfully prepared were studied. In conclusion, it was also shown on the possibility that in the cochlea the transformation of the mechanical into the nervous stimulus results in direct association with the pressure effect of the whirl.

PHYSIOLOGY OF THE LABYRINTH

According to La Reau's [25] view, the arterial pulsations produce lasting pressure changes in movements of the endolymph, as a result of which there are continuous stimulations of the crista ampularis and the cupola. These stimulations are necessary for the maintenance of the labyrinthian tonus. If the endolymph sac were only a rigid tube, the movements in stimulation would not be effective. The saccus endolymphaticus is here considered an important factor and makes possible the movement of the endolymph.

Groebbels [26] discussed the important suppressed reflexes in animals: (1) the rotary reflex which may be looked on as a reaction of the three plane systems of space; (2) the labyrinthian reflex on the head which is influenced by the effect of the labyrinth on the cervical muscles; (3) the cervical position reflex on the trunk and the tonic cervical reflex on the extremities. He determined that the centers from which the

25. La Reau, H. G.: Rev. de laryngol. **49**:539, 1928.

26. Groebbels, F.: Deutsche. Ztschr. f. Nervenh. **107**:154, 1928.

vestibular stimulation is influenced from the labyrinth are the same for the cervical position reflex of the trunk, and (4) motor reflexes which are emanated from the labyrinth.

Experimenting with seventy-four pigeons he reached the following conclusions with regard to the relation of the cerebellum and the vestibular system: Impulses which affect the vestibules from the labyrinths are restrained by other impulses arising from the nuclei of the cerebellum, completed and brought in harmonic relation. Bilateral lesion of the dentate nucleus produces no cervical rotation, but results in a new position equilibrium. A bilateral section of the vestibular center leaves intact the cervical reflex on the trunk. The backward rotation of the neck takes place only by a bilateral and not by a unilateral lesion of the nucleus tecti. The paleocerebellum is an equilibrium regulator which receives, associates and gives up proprioceptive and labyrinthian impulses.

Dusser de Barenne and de Kleyn [27] reported on vestibular nystagmus after extirpation of all six muscles of the eye in a rabbit; and offer a contribution on the effect and innervation of the retractor bulbi muscle.

After crossed transplantation of the horizontal muscles of the eye in a rabbit there is found in the involved eye, in the majority of cases, a normal vestibular nystagmus (according to direction), and the eye on which operation has been performed and the intact eye turn synchronously in the same direction as if there were no crossing. In other rabbits, on the other hand, it is found that after such a transplantation the vestibular nystagmus in the operated eye is in an opposite direction from that in the normal eye; both eyes turn synchronously but in opposite directions. After extirpation of the six external muscles the normal horizontal and vertical nystagmus may still be produced by vestibular stimulation. Except in one case, only a rotary nystagmus could not be produced. This is based on the fact that in such an eye there still exists the four tips of the retractor bulbi muscles; these muscles act as the corresponding four external muscles. These results signify that in such cases the retractor tips are stronger than the muscles. In analysis of the eye movements of rabbits one must therefore consider the function not only of the six external eye muscles but also of the retractor tips.

Fischer [28] in describing the regulatory functions of the labyrinth in man and the association with similar functions, formulated the following basic laws:

1. The labyrinth in man is not only a reflex organ but also a receptive organ for the sensory stimuli, as proved by strict personal observations of reflex studies.

27. Dusser de Barenne, J. G., and de Kleyn, A.: Arch. f. d. ges. Physiol. **221**:1, 1928.

28. Fischer, M. H.: Ergebn. d. Physiol. **27**:209, 1928.

2. One must consider the condition not only of the reception apparatus but of the nerve central organ also. In the physiology of the labyrinth a pure physical explanation does not suffice, but one must consider the biologic factor, the property of the living substances. Great care should be taken when one wishes to draw analogy between animal experiments and the physiology of the labyrinth in man. The monograph may be divided in two large sections; the vestibular apparatus as a sensory organ and the vestibular apparatus as a reflex organ. In the first section is summarized the well known movement sensation after rotation described by the author and Wodak, whereby special attention is called to the fact that for similar experiments not active but only passive movements of change of position of the head are necessary. He confirmed observations by Dodge and previously published by Buys, even though there is too little proof in the sensations during the rotation, as well as for the phasic course of sensation in vestibular stimulation. The Purkinje law holds good only during the first negative phase, a change of the head position after cessation of the rotation leads only then to a Purkinje stimulating rotation when there is an impulse from the periphery into the semicircular canals. After a brief discussion of the movement sensations during and after progressive movement and inadequate stimulation, the author also discussed the influence of the labyrinth movement sensation and simultaneous effect of sound and optic impulses, in the so-called touch vertigo.

In the study of localization of an after-image during and after the rotation, the author reached the conclusion that there exists a qualitative parallelism between nystagmus and the localization of an after-image. The various methods for the determination of the sense of position are thoroughly discussed.

Examination of two patients, one of whom had a unilateral and the other a bilateral loss of the vestibular apparatus, showed that, as compared with the normal, they did not exhibit any basic difference in the localization of the apparent vertical; this shows that the graviceptors of the labyrinths do not play the main rôle in orientation in space (this agrees with Garten's experiments with his rotation chair). In the origin of the sensory position one must therefore also consider the sensibility of depth and probably also of the viscera, while the influence of the labyrinth has not been exactly determined. Such an important function is even more so assured. In the section of the vestibular apparatus as a reflex organ, the author shows that the so-called induced tonus changes in man are more important than the labyrinthian influence of the body musculature.

In the study of compensatory eye position the neck reflexes must be excluded; the author has also found that in man tonic cervical reflexes

play likewise a rôle on the eyes. It is especially emphasized and proved that the fall reaction and vestibular accidents are two different conceptions. It is characteristic for the fall reaction that it appears only under conditions which shall be designated as necessary for the appearance of the Purkinje rotary sensation. Reaction of deviation and past-pointing must be distinctly separated and do not necessarily run parallel to each other. The reflexes of trunk movements and tilting are lacking in complete deafness; they are therefore of a labyrinthian origin. Finally, the author defends his view that the clinical method with a rotation ten times on the rotary chair is placed on faulty ground, since it is associated with interference phenomena.

De Juan [29] has tested the labyrinthian stimulation experiments of Ewald on rabbits. While Ewald in his time experimented with pigeons in which the semicircular canals were destroyed and then permitted the action of a pneumatic hammer on the fistula of the semicircular canals, the author exposed the semicircular canals in rabbits and interposed a section between the compression and aspiration syringe, thus preparing a small pneumatic chamber.

He summarized the results of the five compression and aspiration experiments as follows: 1. Each condensation and expansion of the air in the chamber causes regularly a movement of the eyes. 2. Air condensation causes, as a rule, a stronger movement of the eyes than air expansion. These reflex movements differ also according to the maintenance of the position of the head in space, for example the eye movements are alike in aspiration and compression when the experimental animal lies on its side and the labyrinth fistula is directed downward. 3. Thus, two eye movements are to be differentiated: in compression nystagmus toward the operated side and in aspiration toward the healthy side. 4. No eye movements appear when the utricle is manipulated through the fistula. 5. Variations in the rate of compression and aspiration influence variably the movements of the eye. 6. Slow compression causes a movement of the eyes upward and a rotation of the eyes downward; in condensation this is reversed. 7. The compression is most effective when the animal lies on the side with the operated labyrinth upward. The condensation on the other hand produces strongest reflexes in the side position and the labyrinth directed outward; various positions of the head in space vary the movements. 8. If a strong reaction has been produced by means of a strong compression, it is impossible to produce an opposite reflex immediately afterward by a similarly strong aspiration. 9. The duration of the nystagmus depends on the peripheral labyrinthian stimulation and more on the reaction of the central nervous system.

29. De Juan, Pascual: Rev. españ. y. amer. laring. **20**:1, 1929.

In the course of his experimental studies, Lorente de No[30] investigated two problems:

1. The current in the semicircular canals produced by the rotation of the head is, as Mach has already stated, directly proportional to the cosine between the level of the semicircular canals and the rotary level of the included angle. Is the strength of the rotary reflex also proportional to this angle?

2. If the head is so placed that in rotation no semicircular canal is in horizontal position, in all the semicircular canals there is a lymph current. Are these currents influenced mutually? How are the stimulations of the various semicircular canals associated with the central nervous system? The arrangement of the experiment cannot be given exactly in an abstract. Only that much is given: On a rotating table 2 meters long the rabbit and the registration apparatus are placed, and the muscular twitchings are recorded. The author registers the observations on two muscles at a time, as for example the rectus exterior and internal, the movements of which are magnified ten times by the lever and are always registered at the beginning and the end of rotation, in order to determine the changes of the strength of the nystagmus in changes in the current of the semicircular canals in various positions in space. The author names the position in which the mouth cleft reaches 35 degrees below the horizontal, as the normal position (therefore zero). Proceeding from this, he investigated the twitching at various degrees. Since some of the positions are symmetrically paired with regard to the level of rotation and with regard to the level axis, then the current in these positions must be the same. Similarly the position of zero and 180 have the same force of flow. The nystagmus had a different force in each position. The variations are considerable. The author denies that these variations are influenced by any deformation of the membranous semicircular canal which may not be attached to the bony semicircular canal. He also does not consider the stimulation of the otoliths, but Bárány's determination that the strength of the nystagmus is influenced centrally presents the explanation. By means of higher mathematics the author determined that there existed no current as Favil demonstrated on models, in the vertical semicircular canal, while rotating in the bitemporal axis. Further, the semicircular canals are independent from one another physically; likewise the vertical canals in cases of equally directed currents. Important also is the assumption that the dependence of the currents in the vertical and horizontal semicircular canals must be influenced by the stimulation of the horizontal semicircular canals through the stimulation of the vertical, a biologic process not fully

30. Lorente de No, R.: Arch. Ohr. Heilk. **118**:241, 1928.

explained today. Furthermore, it is of importance that the calculation as to which ocular muscle enervated from each semicircular canal, and what type of muscular nystagmus each current produces, is erroneous. The ocular movements are produced usually by all six ocular muscles and not by one or two—"each semi-circular canal therefore produces nystagmus in the six muscles." The solution of this problem is attempted by the author on the basis of Bárány's assumption of the interposition theory—the transformation of the semicircular canal stimuli in the nerve system. For this purpose the author used a number of experimental animals, the semicircular canals of which were obliterated (filled) and then artificial nystagmus was produced. It is impossible to give the details of the experiment. From the experiments it has been found that the reaction of the semicircular canals to caloric stimulation is dependent on the position of the head in space. Further, the fact that all six ocular muscles generally participate in the nystagmus is well correlated with the mechanics, i. e., the midpoint rotation of the eyes. It has also been shown that the nystagmus resulting from the horizontal semicircular canal is the strongest, this being confirmed by Bárány and many others. The Lorentic experiments have shown that "the stimulation of the vertical semicircular canal in the position of the head which approaches the normal, produces a considerably weaker reaction than the stimulation of the horizontal semi-circular canal." According to the author this is partly based on the fact that the otoliths react passively and thereby determine the position while the semicircular canals perceive the active movements. This is definitely demonstrated in experiments in which the horizontal and the vertical semicircular canals are separately obliterated. The animals behave differently. In the first animals they remain at rest in space while animals with destroyed vertical semicircular canals behave as if a bilateral labyrinthectomy has been carried out. The strength of the nystagmus in the various positions of the head was thoroughly investigated. It appears that the maximum of the nystagmus does not correspond with the horizontal position. The horizontal muscles produce nystagmus in all positions of the head. The rectus internus is usually the muscle with the nystagmus of the greatest amplitude. If the horizontal semicircular canal is placed vertically in space, it is not stimulated. In this position, the direction of rotation being unchanged, there is a reverse of the current. It follows from the experiments that the reverse of the nystagmus does not coincide with the vertical position of the horizontal semicircular canals. All these experiments appear to explain that the individual semicircular canals are not associated with the individual groups of muscles but obviously with all. In positions of the head in which the horizontal semicircular is in a vertical position, the vertical semicircular canal produced the

strongest nystagmus, and the nystagmus twitchings are here frequently stronger than in the optimum position of the horizontal semicircular canal. In positions of the head in which a reverse of the horizontal nystagmus takes place, the vertical canals diminish their strength without changing the direction. This can be understood only when the details of the experiments are studied. A series of experimentally obtained phenomena in examination of the individual muscles in the beginning and at the end of a rotation are "imitated" by lesions of the vestibular nucleus. In general the experiments show that the flow of the lymph should not be followed by a definite nystagmus, the determination of the direction of a nystagmus must be the problem of the nervous system, since for it summation of stimuli are necessary. Experimentally the author succeeded to prove that the horizontal muscles at the beginning and toward the end of the excentric rotation exhibit the same nystagmus. Finally the author believes that by Breuer's theory alone it cannot be explained why the reflexes at the beginning and at the end of the rotation are qualitatively different.

This contribution by Nylen [31] comes from the Experimental Labora tory of the Oto-Rhino-Laryngological Clinic of the Sabbatsberg Hospital in Stockholm, Sweden. The majority of investigators who have experimented on the labyrinth, have removed or plugged certain portions of the labyrinth, by some procedure or other. It is rather peculiar, at least with respect to plugging, that the experiments generally worked with the semicircular canals, whereas strange to say, the vestibule was left out. However, the introduction of a minimal quantity of amalgam or a similar product into this site of the otoliths is followed under certain conditions, among other phenomena, by nystagmus related to the positions of the head, and of variable aspect. Not only this last manifestation which seems to occur also when a single labyrinth is present, but also the fact that on the part of the eyes, apparently only deviation in various directions is obtained but no nystagmus, led the author to make another addition to the numerous labyrinthian theories already in existence. The amalgam which is introduced into the vestibule and partially fills it, is in contact with the lining membrane which separates the lower portion of the labyrinth from the upper portion; or it comes to lie in such a way as to produce a modification of pressure or a displacement in the upper portion (close to the utriculus and the semicircular canals), and nystagmus appears in certain positions of the head. In the experiments on rabbits, the amalgam-filling, primarily introduced into the lower portion of the labyrinth, penetrated in certain positions of the head to the sacculus and utriculus, which like the semicircular canals functioned in an entirely normal manner; the penetration of the amalgam

31. Nylen, C. O.: Acta oto-laryng. **13**:312, 1929.

took place under such conditions that a positional nystagmus resulted. In another intervention, the amalgam was pushed into the horizontal semicircular canal; under this action, the ampullary organ of the canal underwent no anatomic change, but presented a simple functional disturbance; finally, nystagmus supervened, slightly dependent on the position of the head and derived from the healthy side. The otolithic organs, however, functioned a little less strongly on the operated side. A second experiment began with a left sided labyrinthectomy, several months before the introduction of the amalgam into the right labyrinth. The last named procedure resulted in the production of a positional nystagmus (which could not be previously obtained) in the case of a left lateral reclining attitude, in which the rotary counter movements of the eyes were the least marked. The animal was killed in this position, and the successful histologic preparation of the specimen showed that here again, the amalgam had almost entirely left its original position; it was replaced by Chinese ink, which in its turn completely expelled the amalgam. The ampullary otolithic organs were perfectly demonstrable, without defects. The author arrived at the following conclusion: In a case with only a single labyrinth, the amalgam produced a positional nystagmus by coming in contact on lateral inclination of the head, with the utricular wall and acting on it, but without violence. In the opposite lateral inclination, the action of the amalgam had the effect that the otolith of the healthy utricle which essentially produces the deviation of the eye was so strongly stimulated as to prevent the appearance of the positional nystagmus. All the foregoing observations support the author's theory that positional nystagmus does not depend on a primary lesion of the vestibular organs themselves, but on anatomopathologic changes, of some kind or other, occupying the perilymphatic space, at the same time as on the intralabyrinthine variations of pressure and motion, which follow on the different positions of the head. His theory concerning the positional nystagmus is therefore equally applicable to other vestibular reactions.

OTOLITH PHYSIOLOGY

Kompaneitz [32] had the opportunity to test in two patients the function of the otolith apparatus. In one case he had to deal with a female patient who suffered with acute dizziness, vomiting and spontaneous nystagmus of the third degree toward the right. The hearing was normal on the right and on the left. The patient could feel comfortable only when lying on the abdomen with the head on the right ear. The caloric test presented normal results. The diagnosis was left labyrinthitis. By numerous tests of the otolith apparatus in the course of

32. Kompaneitz, S. M.: Vrach. dïelo **10**:1824, 1928.

a few months the author concluded that this deviation was greater in inclination of the head 60 degrees to the healthy side. In inclination of an angle of from 10 to 40 degrees to the healthy side, the eye deviates more to the similar side than to the other side. In the second patient there appeared suddenly a left sided deafness, and difficulty in hearing on the right side; the left labyrinth was not stimulated calorically while the right was. In inclining the head toward the right the opposite deviation at first was ten times stronger than on inclination toward the left. The author sees in his results a confirmation of the view of Magnus and Klein that not the pressure but the pull of the otoliths on the macula produces the maximum stimulation.

The question as to how the otolith apparatus functions is still unsettled. Quix still persists in his view that the pressure of the otoliths on the macula produces a maximum stimulation. In a recent article Quix and Eijsvogel [33] reported their experiments on the function of the otolith. The experiments presented here have to deal with three types of conditions. In the first place, they wished to determine whether the otolith apparatus takes part in the vertical head position; in the second place, whether in man as well as in animal, the reflexes produced by the labyrinth maintain the head unchanged in relation to the vertical position when the body assumes another position in space; and finally, how the known past-pointing error is carried out in a definite otolith position (maximum or minimum pressure position).

1. The perception of the body position to the vertical: The relation found between the otolith pressure and the perception of position is a proof that not the contraction but the otolith pressure is to be looked on as a specific stimulus for this sensory organ. Conclusively they stated from various observations that the otolith organs participate in the complicated position of the body position in space.

2. Changes of the labyrinthian reflex on the neck with the position of the body: With regard to this question they stated that there does not exist in man a compensatory contrarotation of the head in changes of the head position as the case in animals. There was constantly observed a contrarotation of the head around the vertical axis in rotation of the body around the sagittal axis. These contrarotations, however, cannot be looked on in the sense of compensatory, since the position of the head is maintained constantly at a vertical level.

3. The pointing experiments in various positions of the body: The results of these experiments are interesting. It has been found that when the normal relation between the otoliths and the cervical reflexes is interrupted, there is no past-pointing with the hand of that side on

33. Quix, F. H., and Eijsvogel, M. H.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **23**:68, 1929.

which there is pressure of the regulating otolith, but there is a past-pointing error with the hand on that side on which the otolith is functionless. The otolith is still able to carry out properly the past-pointing error when the normal relations to the neck reflexes are interrupted in those cases in which the otoliths are still functioning; if the otoliths are out of function, then the past-pointing error experiments cannot be carried out. If the pointing experiment is carried out while the head is in the blind spot position, then all experiments are negative, the errors being so great that regularity can no longer be recognized. For otology, these experiments are of considerable importance since the pointing experiments can be carried out exactly when the fixed head is only in a definite position, and in other positions a physiologic past-pointing error already exists.

Blumenthal [34] tested the influence of the position of the head on past-pointing in twenty-eight patients but did not obtain any definite results. These variations of the effect he ascribed to the mechanical and psychic effect of the movement itself; depending on whether the patient held his neck fixed or whether this position was held without any psychic concentration, there resulted a movement in the shoulder girdle and the arms which was with the position of the head or against it, whereby in similar experiments the results were different.

PHYSIOLOGY OF CALORIC REACTION

De Kleyn and Versteegh [35] stated that in mammals the caloric reaction probably originates in the semicircular canals. From their experiments they base the following: 1. The direction of caloric nystagmus depends on the position of the horizontal semicircular canal. 2. A normal caloric nystagmus may be provoked (*a*) after having destroyed the otolithic membranes of a guinea-pig by centrifuging; (*b*) after extirpation of all the saccular macula. Clinical methods of examination of the caloric reactions of the labyrinth only with cold water and with the head in only one position may cause errors of interpretation in regard to the vestibular reflexes of the labyrinth.

Traina [36] considered the lymphokinetic theory insufficient to explain the vestibular reactions, but believed that in the caloric vestibular tests, other factors as the thermic stimulation of the nerve terminals and the vasomotoric disturbances are effective. In order to show that the warm or cold irrigation acts as a thermic stimulus independent from the lymph

34. Blumenthal, A.: Ztschr. f. Laryngol., Rhinol. **18**:4, 1929; abstr., Ztschr. f. Hals-, Nasen-u. Ohrenh. **14**:100, 1929.

35. De Kleyn, A., and Versteegh, C.: Rev. de laryngol. **49**:695, 1928.

36. Traina, S.: Valsalva **4**:501, 1928; abstr., Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:468, 1929.

movement, he interrupted the endolymphatic channel in the pigeon by closure of the bony semicircular canal with silver; by sectioning, ligature, etc., by bilateral removal of the soft semicircular ducts. The experiments have shown uniformly that after removal of the endolymph circulation, the vestibular nerve may be stimulated thermically as well as galvanically, while the rotary tests no longer produce any stimulation.

Veits [37] studied the problem whether the caloric vestibular reaction is simply a parallel phenomenon to the nonphysical process in the inner ear. With the aid of a pulsion reflex he determined how the nystagmus is procured in the living subject and in the indifferent position, i. e., that position in which no reaction appears. The author could prove, by placing two lead plates on the horizontal semicircular canals in two operated patients, the indifferent position with the proper position of the external semicircular canal. Further, the author determined by means of curves the duration of the propulsion and retropulsion reflex in various positions of the head. He showed thereby that the maximum 90 degrees is removed from the indifferent position. The same was obtained in registration of the pulsion reflex in suspension. Quite striking was the fact that the latent period showed considerably shorter absolute value after hot irrigations than after the corresponding cold irrigation. Also after unilateral calorization the nystagmus shows the same dependence on the position of the labyrinth to the direction of gravity. But here also different variations are found between hot and cold irrigations. It is of special significance that the measured duration of the pulsion reflex in various periods between a double cold irrigation in indifferent position and the passage into a maximum position agrees graphically with the rate of flow of endolymph determined numerically by Schmaltz, and especially, that both curves after a certain period show a return. Similar results are obtained by registration of the pulsion reflex in the suspended experimental subject and the number of nystagmic movements after a unilateral irrigation. Here was never observed a reverse of the nystagmic direction. In a slow reaction at the point of stimulation there was no effect, while the change in rate which plays the main part is too slight. From all these comparisons between the physiologic experiments and the physicomathematic deductions, it follows that the endolymph current plays an important part in the production of the reaction which, however, is in no way the decisive factor. In conclusion the author stated that after a simultaneous double irrigation with water in the indifferent position which remains ineffective, the threshold stimulus for the galvanic vertigo and nystagmus is raised.

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37. Veits, C.: Acta oto-laryng. **13**:94, 1928; abstr., Ztschr. f. Hals-, Nasen-u. Ohrenh. **13**:732, 1929.

GALVANIC REACTION

Dohlman [38] conducted experimental investigations on the galvanic vestibular reaction. This is truly an exceptional study, remarkable for its detail, summarized briefly: 1. The investigations confirm that the galvanic reaction is of no value in the judgment of the functional condition of the peripheral labyrinth or its sensory epithelium. 2. The galvanic reaction terminates in the ganglion cells and shows thereby the presence of a functional activity of the ganglion cells. 3. After a bilateral extirpation of the labyrinth the labyrinthian symptoms on one side may be reestablished by an additional unilateral destruction of the vestibular ganglion. This shows that the ganglion possesses a certain "tonus" which maintains an equilibrium with the labyrinthian organs of the opposite side. By disturbing this equilibrium there results nystagmus in man. Such a disturbance may be produced by galvanic current, depending on the direction of the current which produces an increase or diminution of the tonus of the vestibular ganglion and thereby a nystagmus reversible to the direction of the current. 4. Through injuries to the vestibular nucleus which bring about changes or loss of the tonic reflexes of the eyes (in rabbits), there also result changes or disappearance of the galvanic reaction in maintained semicircular canal reflexes.

CLINICAL

Rosenblatt [39] gave a summary of his observations on compensation nystagmus occurring in the rotation tests after complete loss of labyrinth function, and its inference. The puzzling problem which surrounds the occurrence of partial or complete compensation to the effects of rotation after total loss of the labyrinth on one side has prompted the author to analyze six cases illustrating this condition. His conclusions are: 1. As already recognized, compensation to the rotation tests does not necessarily indicate complete healing of an affected labyrinth. Even with compensation a latent labyrinthitis may give rise to intracranial complications. 2. With the removal of a complete sequestrum of the labyrinth (as determined by both clinical and anatomic examination) compensation may not always be established. 3. The presence of compensation does not always mean loss of function of all the terminations of the vestibular nerve. 4. Compensation is not established with respect to all the canals simultaneously. The horizontal canals are the first to be compensated. 5. The coexistence of a chronic otorrhea which does not give rise to urgent symptoms, with a loss of function of the corresponding labyrinth indicates that surgical intervention should be avoided if possible. 6. If, however, an operation on the middle

38. Dohlman, G.: Acta oto-laryng., Uppsala, Supplement, 1929, vol. 8.
39. Rosenblatt, N.: J. Laryng. & Otol. **44**:278, 1929.

ear has to be performed, it should be followed by preliminary opening and examination of the inner ear, and further procedure should be guided by the result of such inspection.

Sommer and Yaskin [40] summarized their observations as follows: In fifty consecutive cases which were investigated in an otologic clinic in Vienna to determine the occurrence of nystagmus and vertigo in certain positions of the head and in head movements other than those around the long axis of the body, twelve patients had combined nystagmus and vertigo and seven only vertigo, while thirty-one gave no response. 2. No etiologic relationship could be established between these phenomena and any clinicopathologic condition. All but one of the nineteen patients had normally irritable labyrinths. Ten patients had cochlear hypofunction and seven chronic processes of the middle ear, forming no striking contrast with the thirty-one cases which did not reveal either nystagmus or vertigo. 3. The results would assign the immediate cause of these phenomena to increased susceptibility of the semicircular canal component of the labyrinth. This does not mitigate against the occurrence of these signs in lesions of the brain stem and the parts of the central nervous system, as reported in the literature. In the cases studied by these authors, however, there was no evidence of any such lesions. 4. These two signs by themselves are not indicative of a serious condition either in the peripheral or in the brain stem. In themselves they are not sufficient indications for establishing diagnosis of a serious condition either in the ear or brain stem and are not indications for surgical intervention.

Stscheglow [41] described three cases of head nystagmus and concluded that the material is too small to justify final conclusions, but these cases and others reported in the literature seem to show: (1) that as the head nystagmus was brought about by pressure on the fistula of the labyrinth it is beyond doubt labyrinthine in origin; (2) in many cases head nystagmus is important in diagnosis; and (3) it is impossible as yet to say why head nystagmus occurs in some cases of irritation of the labyrinth and not in others.

As in animals on irritation of the labyrinth the reflex runs chiefly on the vestibulospinal tracts and produces a nystagmus of the head but not of the eyes, it seems justifiable to conclude that the vestibulospinal tracts are the older phylogenetically. But in man the vestibulospinal tracts are of predominant importance in reflexes originating from the labyrinth only in infancy. With the constantly increasing differentiation of the central nervous system and the nerve muscle tracts in adults in the course of development the vestibulospinal tract decreases in importance; vestibulonuclear conduction becomes the chief tract for reflexes

40. Sommer, I., and Yaskin, J. C.: Ann. Otol. Rhin. & Laryng. **38**:260, 1929.
41. Stscheglow, F.: Arch. f. Ohrenh-. Nasen- u. Kehlkopfh. **121**:291, 1929.

originating from the labyrinth. Therefore in man irritation of the labyrinth normally causes eye nystagmus; it causes head nystagmus only in a few pathologic cases. This may be considered to a certain extent an atavism.

Quix [42] explained the methods of examination of the vestibule of the ear. This article should be read in the original to be fully appreciated. Heretofore study of the function of the vestibule has been limited largely to the horizontal semicircular canal. The function of the two vertical canals has been little studied, and that of the otoliths has been neglected completely. In the vestibule of each ear there are five distinct sensory elements, three crests, one in each canal, and two macules. Each of these elements has a special function. In order to examine the function of the vestibular organ as a whole which is a double organ made of the two vestibules, it is necessary to examine each of these ten elements. Diagrams are given showing the anatomy of the internal ear, an analysis of the movements produced by stimuli, such as cold water for instance, and the results of pointing tests in different pathologic conditions. The author says in conclusion that lack of clearness to his exposition of the facts is due partly to the complexity of the functions of the vestibule and partly to the slight knowledge of physics and geometry possessed by most physicians. The examiner must first have a clear picture in his mind of the topographical situation of the different elements in the vestibule and an exact understanding of the mechanical forces set in motion by straight and rotary movements, the breaking up of these movements into their components, and the recombination of these components. In order to simplify the matter somewhat he arranges the tests and their results in two tables. The first table shows the test for each element in the vestibule and the diagnostic significance of spontaneous deviations. Column 1 shows the element to be tested; in a canal it is always the crest, in a utricle or saccule it is the macule. Column 2 shows the test to be used and the arm that is to be used in pointing; column 3 shows the number of the test; column 4 shows the nature of the functional disturbance if the deviation is negative and column 5 when it is positive. In table 2, column 1 shows the test to be made, first for the right arm and then for the left. When the deviations are negative, the diagnosis is indicated in column 3; when they are positive, it is shown in column 4. The author thinks if the physician will make the different tests of rotation, irrigation, etc., bearing in mind the law of physics, and record them in accordance with these tables, he will finally begin to see that the function of the vestibule is simpler than it seems to be and that much of its apparent complexity is due to limited knowledge and imagination on the part of the examiner.

42. Quix: Arch. internat. de laryngol., otol., rhinol. **35**:133, 1929.

VASOMOTOR PHENOMENA

Portmann,[43] who has done as much as any one in investigations of vasomotoric disturbances of the ear, made a survey of this interesting condition. In this article nothing new has been added to what he has already done, and it is evidently intended for his English readers and followers. He analyzed the various symptoms that occur in vasomotor conditions of the ear. In whatever manner the ear is affected it seems to be definitely agreed on that vasodilatation produces a hypo-excitability and vasoconstriction a hyperexcitability.

The angiospasmodic syndrome of the labyrinth consequently includes: (1) tinnitus; (2) deafness, vestibular excitability tinnitus; and (3) sympathetic hypertony. On the other hand, there is a syndrome of hypertonicity of the labyrinth whereby there is tinnitus with vestibular hypo-excitability and sympathetic hypertony. Furthermore, these two syndromes may succeed each other alternately in the same patient.

He stated that the most diverse causes will be found for these vago-sympathetic troubles. The causes may be mechanical, endocrine toxic or even simply psychic. The most important causes susceptible of acting on this regulating apparatus are undoubtedly the action of the nervous system and the action of the endocrine glands and above all the hormone of the suprarenal glands, epinephrine.

None of the investigators in this particular field are emphatic and leave themselves open to change their present opinion as to the symptoms in these so-called angiospasms of the ear.

Muck [44] asserted to have definite proof of vasoconstricture of the auditory artery during stimulation of the ear labyrinth. He obtained tracings of the vasoconstricture reflex phenomena after caloric stimulation of the labyrinth. He asserted that the white tracings as shown are signs of an increased irritability of the vessel of the brain and in this case of the auditory artery. In complete unilateral deafness when the labyrinth could not be stimulated calorically, tracings could not be obtained. In complete deafness especially in congenital deaf mutism if the nystagmus could be obtained calorically, then the tracings could be demonstrated. On the other hand in deaf mutism in which the labyrinth could not be stimulated calorically, the vasoconstricture phenomena on the tracings are not demonstrable.

Berggren [45] reported his studies on the effect of bulbocapnine on spontaneous nystagmus in man. In a previous work he demonstrated the influence of bulbocapnine on nystagmus experimentally produced in rabbits, and attempted to analyze the point of attack of the drug on

43. Portmann, G.: Ann. Otol. Rhin. & Laryng. **38**:69, 1929.
44. Muck, O.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **22**:443, 1929.
45. Berggren, S.: Acta oto-laryngol. **13**:233, 1927.

the reflex arc. It was shown in that work that bulbocapnine injected intravenously in applicable doses exerted no effect on the ocular muscles and the nucleus of the ocular muscles. The effect of bulbocapnine in this case is due to its action on the vestibular region, mainly on the nuclear region of vestibular nerve and possibly also on the peripheral labyrinth.

He used 0.1 Gm. injected subcutaneously, and only one injection was necessary to obtain the full effect. The oral administration is just as good as is the subcutaneous; in the oral method, however, the maximal effect is obtained in about five hours after administration, while in the subcutaneous method it becomes effective in ten minutes and lasts from two to three hours.

Twelve cases were studied of spontaneous nystagmus in man, two of which were of the optic type, ten the vestibular type. The material was divided into the following groups: (1) optic nystagmus; (2) vestibular nystagmus as a result of labyrinthitis and chronic otitis media and (3) vestibular nystagmus in Menier's disease.

In summarizing the results of his experiments with this drug it may be stated that by injection of from 0.05 to 0.1 Gm. of bulbocapnine there is no effect on the existing optic nystagmus. In spontaneous vestibular nystagmus on the other hand, whether of central or peripheral origin, bulbocapnine exerts an inhibitory effect on the nystagmic movements and causes a diminution and even a cessation of the subjective symptoms of vertigo. This influence of subcutaneously injected alkaloid is produced in most cases, lasting after doses of 0.1 Gm. for the entire day, and it apparently favorably influences sleep. It appears that bulbocapnine exerts its effects on the vestibular region as shown in man as well as in rabbit, and that bulbocapnine is a drug which will eliminate symptomatically the vestibular vertigo and nystagmus. Further experiences would establish the value of bulbocapnine in these cases. It would be of interest to study experimentally this drug in cases of seasickness.

Pallestrini [46] has done considerable work in determining the action of various drugs on the labyrinth. Pilocarpine hydrochloride, U. S. P., he stated acts partly as a hyperirritant and as a hypo-irritant. Retroauricular injections of epinephrine produce a rotary nystagmus to the opposite side. Local injection of apocodeine if used previously prevents this vasomotoric nystagmus.

Alexandroff and Talpis [47] reported the influence of acute and chronic alcohol intoxication on the labyrinth. Acute alcohol poisoning produces

46. Pallestrini, E.: Riv. oto-neuro-oft. **6**:27, 1929.

47. Alexandroff, J., and Talpis, L.: Monatschr. f. Ohrenh. **62**:1196, 1928; abstr., Ztschr. f. d. ges. Neurol. u. Psychiat. **53**:13, 1929.

in animals a consistent loss of reaction of the position reflex group. Chronic alcohol poisoning in animals produces at least a definite shortening of the latent period of the position reflex and some lowering of the tonus. A permanent interruption of introduction of alcohol in animals produces anew a prolongation of the mentioned latent period. There exists a certain analogy between chronic users of alcohol and animals which have been maintained for a long time on alcohol.

Terracol,[48] who has studied the action of various drugs on the labyrinth, reported further experimental work. The action of epinephrine and of the extracts of other endocrine glands as well as of acetylcholine on the function of the labyrinth was investigated. It was found that a hyperexcitability as well as hypo-excitability of the labyrinth could be returned to normal by peroral administration of epinephrine or, rapidly, by intravenous injections of suprarenal extract. While, theoretically, acetylcholine should result in a dilatation of the vessels of the labyrinth, no influence on the functions of the labyrinth could be determined with this drug and with other endocrine glands.

Talpis and Wolfkowitsch [49] tested and confirmed on man the experiments which were previously carried out on rabbits with regard to lowering of the vestibular blood pressure. The first type was an initial rise, a rapid fall and a slow balance. The second type of pressure was a gradual fall from six to eight minutes, and then a slow balance of the blood pressure. The third type, a rapid oscillation in lowering and rising of the blood pressure, was found in tuberculous patients with labile vegetative nervous systems. In nonirritable labyrinths (mutes) a change in blood pressure was not observed in twenty of twenty-six patients; in the remaining subjects, it was slight.

Spiegel [50] discussed the three-fold dependence of the internal ear on the vegetative nervous system, the state of contraction of the supplying arteries, the permeability of the vascular wall and the changes in the blood pressure. The author presented some data about the vasomotor innervation of the labyrinth, and carried out some experimental studies on the vasoconstrictor influence on the labyrinth function and of the vasomotor disturbances in general of the internal ear in man, with regard to hypertonia, migraine and neurosis. He also studied the influence on "angio neurotic octavus crisis," the otitis interna vasomotorica after concussion of the brain and the vestibular irritation phenomena and changes in blood pressure.

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48. Terracol, J.: Rev. de laryngol. **50**:7, 1929; abstr., Ztschr. f. Hals-, Nasen- u. Ohrenh. **14**:48, 1929.

49. Talpis, L., and Wolfkowitsch, M.: Monatschr. f. Ohrenh. **62**:1278, 1929; abstr., Ztschr. f. d. ges. Neurol. u. Psychiat. **53**:16, 1929.

50. Spiegel, G. A.: Rev. oto-neuro-oft. **4**:19, 1929.

This article by Stein [51] was considered of such interest that an unusually long review was given. While it is of clinical rather than physiologic importance, so little is known about this condition that it is presentable at this time. The thorough internal examination to which the author subjected every patient with earache or disagreeable sensations in the ear for which no local pathologic substratum could be found, showed that these sensations were due to disturbances of circulation. These patients showed distinct general functional (vasomotor) or organic (arteriosclerotic) disturbances of circulation. The usual attack-like nature of the earache, its combination with attack-like noises in the ears or bad hearing and especially the simultaneous similar sensations in other parts of the body, seem to indicate vascular spasms. The favorable effect of vasodilating drugs confirmed this assumption.

If the angiospasm leading to the painful or disagreeable sensations are of a vasomotor nature, they are a partial symptom of neurasthenia. Neurasthenia is intimately connected with the circulatory apparatus. Anomalies of internal secretion may release them, as the vasomotor apparatus is greatly influenced by the hormones.

Ear troubles often appear or are exacerbated before menstruation and are then associated with other symptoms or sympathetic excitation (increased pulse, palpitation, fear, tremor, increased blood pressure, etc.). Women with ovarian dysfunction and in the climacterium are especially subject to subjective and objective disturbances of the ear. The sensations are transmitted by a labile vasomotor center.

It is noteworthy that many of the patients observed by the author were affected with nervous hypertonia (increased blood pressure in the presence of only slight objective symptoms from the part of the circulatory apparatus).

The earache was associated with sensations of pressure in the chest and cardiac region, tinnitus, a heavy head, general fatigue, etc. At times the symptoms of the ear, and at other times the other symptoms prevailed. The condition oscillated in accordance with the psychic condition of the patient. If the angiospasms are of an arteriosclerotic nature, the earache and its associated sensations (vertigo, headaches and disturbances of sleep) are a part of the syndrome of arteriosclerosis in general and of cerebral arteriosclerosis in particular. The sensations vary greatly. They are usually unilateral. They are described by the patients as pressure, tenseness, lancinating pains or spasms. They usually last for seconds or minutes only, but recur several times during the day. Sometimes they appear sporadically in the course of days or weeks. In three cases an excessive sensitivity to pressure of the mastoid process was present. Such a sensitivity may be an effect of myalgia in the musculature of the head and neck.

51. Stein, Conrad: Wien. klin. Wchnschr. **41**:1469, 1928.

Angiospastic otalgia is not so much a pain as a number of disagreeable sensations paresthesias, heat and cold, pressure on weight, sensitivity to acoustic excitation, pruritus of the external meatus and soreness in the presence of an intact skin.

The diagnosis of angiospastic or angiosclerotic otalgia can, of course, be made only if inflammations of the ear and adjacent parts are out of the question. The tympanum must be intact. The quality of the hearing is immaterial, unless there are great differences during and between attacks. These negative otoscopic and rhinolaryngoscopic observations must be associated with those of vasomotor excitation and general functional disturbances of circulation, such as dermographism, increased tonus of the radialartery, acceleration or lability of pulse in relatively trivial exertion, fluctuations of blood pressure, respiratory irregularity of pulse, etc., or there must be the characteristic symptoms of cerebral arteriosclerosis, headache, vertigo and decrease of memory.

The treatment must be individually adapted to the psychic condition of the patient. The physician should listen attentively to the complaints. Very often the assurance that they have no organic ear troubles relieves the patient. Acute attacks and recurring pains or sensations should be treated both symptomatically and causally. Applications of heat and antineuralgic preparations combined with caffeine (0.1 Gm. per dose), papaverine (0.05 Gm. per dose) or codeine usually relieve the attack. Bromides combined with a valerian preparation should be prescribed from a protracted use.

In case of nervous or arteriosclerotic hypertonia, especially in case of cerebral arteriosclerosis with symptoms from the part of the internal ear, theobromine sodio-salicylate (calcium theobromine sodio-salicylate 0.5 Gm. three times a day) should be given in several courses of four weeks with intervals of four weeks. In case of severe pains caffeine or papaverine may be added to every dose; in insomnia, 0.3 Gm. of phenobarbital or theominal may be added to the evening doses. Theominal is a combination of theobromine and phenobarbital.

In a few cases of patients with high blood pressure, tinnitus, vertigo and painful sensations, the author gave potassium thiocyanate with a favorable result. The remedies of the nitrite group, especially sodium nitrite, are also favorable, owing to their vasodilating effect. Climasan combines the effect of theobromine and nitroglycerin and is especially indicated in the climacterium. If hormonal disturbances are diagnosed, an appropriate organotherapy must be instituted. Any local application of heat, especially diathermy, has a favorable effect. Coffee, tea, alcohol and smoking should be forbidden, or at least restricted. A general treatment, aiming at the improvement of the entire vasomotor system (diet, baths, physical therapy, psychotherapy, etc.) must be adapted to all the details of the internal examination.

TUMORS OF THE NOSE AND THROAT

A REVIEW OF THE LITERATURE *

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NOSE

Denker [1] described his technic for the treatment of malignant tumors of the nose. He believes that radical operation with or without irradiation is the best method of treatment, and that the various types of cautery and electrolysis have not stood the test of time. Only radical measures are of any use, except in cases of pedunculated tumors. Diathermy is still under consideration. Secondary hemorrhages, the injury of healthy tissue or occasional secondary toxemia, as well as the slow healing and bad odor, are disadvantages, and, on the whole, surgical procedures are preferred. The author suggested that the good results achieved by Holmgren, New and Merten are due to radium treatment following diathermy. He cited the mortality rates of various investigators but did not cite his own.

NASOPHARYNX AND PHARYNX

Jung [2] described the procedure used in the Breslau Clinic in cases of nasopharyngeal fibromas. Twenty patients were seen in twenty years at the clinic; of the ten treated by radium and roentgen rays, five were seen later and found to be well. The condition of one had not changed; in three, the condition grew steadily worse. Jung stated that the difference between the successful and the unsuccessful cases was due to the dosage of radium. In spite of these favorable results, he believes that operation is the best treatment. He uses Zimmermann's technic. Six such operations were performed on patients between 14

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1. Denker, Alfred: Ueber Behandlung und Heilungsaussichten der bösartigen Nasengeschwülste, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **122**:45, 1929.

2. Jung, G.: Zur operation der Basalfibroide, Ztschr. f. Laryngol., Rhinol. **17**:231 (Dec.) 1928.

and 28 years of age; in one case in which the tumor was very large, death followed surgical intervention, and in the remainder of the cases the patients were cured or much improved.

Bertolotti [3] described twenty-six malignant tumors of the nasopharynx, thirteen of which were of the lateral wall, six of the vault and seven involved the maxillary sinus and extended to the maxillopharyngeal space. The tumors of the vault are likely to extend under the dura; they do not cause early clinical signs. Symptoms may be similar to those of tuberculous meningitis. Tumors of the lateral nasopharynx may give rise to deafness, and symptoms may simulate tic douloureux, and cause headache and paraphagia or ophthalmoplegia. Symptoms of compression of the foramen lacerum medium may follow. In one case there was vertebral metastasis.

Hansel [4] reported twelve cases of malignant nasopharyngeal tumors; two were lymphosarcomas and the others were carcinomas. The tumors were all small, with only slight ulceration. Almost invariably they occurred in the fossa of Rosenmuller, from which they invaded the surrounding structures. The most prominent symptoms were those involving the eye or the cranial nerves. The upper cervical lymph nodes were often very large. The various syndromes to which nasopharyngeal tumors may give rise were reviewed. Hansel considers all nasopharyngeal malignant lesions to be fatal. The preferred treatment is irradiation.

Trotter [5] described operations in cases of malignant disease of the pharynx. The region which he included in his operations extends from the tip of the epiglottis to the lower border of the cricothyroid. He divided his cases into four groups: (1) superior, involving the epiglottis or glosso-epiglottic fossa; (2) lateral, involving the aryepiglottic fold, the pyriform sinus and the lateral pharyngeal wall; (3) posterior, involving the posterior pharyngeal wall, and (4) the inferior, involving the postcricoid pharynx. The latter two groups fall into a class by themselves, because a plastic operation is necessary in order to reconstruct the parts destroyed or removed. He considers three points to be of primary importance: (1) correct exposure and complete removal, (2) prevention of sepsis and (3) preservation of function. He prefers the scalpel to diathermy, as it permits suturing after removal of the malignant lesion and gives a better idea of the exact

3. Bertolotti, M.: L'invazione pavimentosa dei tumori dell'epifaringe, Minerva med. **9**:49 (Jan.) 1929.

4. Hansel, F. K.: Malignant Tumors of the Nasopharynx, Arch. Otolaryng. **9**:12 (Jan.) 1929.

5. Trotter, W.: Operations for Malignant Disease of the Pharynx, Brit. J. Surg. **16**:485 (Jan.) 1929.

extent of the growths. He described carefully his technic and considered the advisability of block excision following operation. It is his belief that infection, usually in the lungs or neck, is the main cause of death, and that the best prophylaxis against infection is the removal of all teeth before operations. He did not give statistics.

Ewing [6] reviewed the histology of epitheliomas of the nasopharynx, with especial regard to the lympho-epitheliomas. He accepts the term, lympho-epithelioma, for epidermoid carcinomas which arise from modified epithelium of lymphoid structures. After classifying exactly the different types of tumors in the nasopharynx, the tonsils and the base of the tongue, he found that of 100 tumors of the nasopharynx, 30 per cent were squamous cell epitheliomas, 37 per cent transitional cell carcinomas, 15 per cent lymphosarcomas and 11 per cent lympho-epitheliomas. The remainder were malignant adenomas and adenoid cystic epitheliomas. Of 200 cases of malignant tumors of the dorsum and base of the tongue, he found 72 per cent to be squamous cell epitheliomas, 12 per cent transitional cell carcinomas, 9 per cent lymphosarcomas and 4 per cent lympho-epitheliomas. He did not classify the remainder.

Samengo [7] described his technic for diathermy in nasopharyngeal tumors by means of a bipolar and tetrapolar electrode. Various instruments have been devised by him for use in extirpating ali kinds of malignant growths of the upper air and food passages.

MOUTH

Moure [8] described twenty-three cases of carcinoma of the tongue, in nineteen of which (82 per cent) cure was effected permanently so far as the primary growth was concerned. However, there were only nine cases in which the lymph nodes were not involved later, which brings the total of permanent cures to 43 per cent. He compared the value of surgical measures and of radium. He believes that biopsy is unnecessary for diagnosis, and that it entails some danger. He prefers radical operation, accompanied by bilateral block excision of the lymph nodes, to irradiation. The prognosis is unfavorable if metastasis is present, but it is his belief, nevertheless, that treatment should be attempted.

6. Ewing, J.: Lymphoepithelioma of Nasopharynx. Am. J. Path. **5**:99 (March) 1929.

7. Samengo, L.: Diatermia quirúrgica y neoformaciones del cávum, Rev. de especialid. **3**:307 (Aug.) 1928.

8. Moure: Le traitement des epithéliomes de la langue, Bull. et mém. Soc. Nat. d. Chir. **54**:1400 (Dec. 22) 1928.

Harmer [9] described his treatment by diathermy for carcinoma of the tongue. He frequently combines irradiation with diathermy, and follows Broders' classification of epitheliomas. If there is no evidence of metastatic lymph nodes, he does not remove the lymph nodes of the neck, but observes the patient periodically. If metastatic growths are palpable, he performs unilateral block dissection. If there is any doubt as to the presence or extent of metastasis, he gives radium in large amounts and roentgen treatment over a wide area.

Dorrance and McShane [10] reported 164 cases of carcinoma of the tongue and floor of the mouth observed by them between 1922 and 1928. The ages of the patients varied between 28 and 86 years; 62 per cent of them were between 50 and 70 years. Eleven of the patients were negroes; seven were women. In most of the cases the duration of the disease was short, an average of about one and a half years. The Wassermann reaction of the blood was tested in 112 cases and was found to be negative in 74. The malignant condition seemed to be more virulent in those cases in which the Wassermann reaction was positive. In most of the cases the condition was far advanced when the patient was first seen, precluding the necessity of biopsy. The authors recommend, however, that a pathologic diagnosis be made before treatment is instituted. Many of the patients had been operated on elsewhere. The treatment varied from irradiation alone, to radical surgical procedures. In more than half of the cases metastasis was far advanced, and the patients died within six months. In the remainder, the condition was advanced. Operations included seven electrocoagulations, four gastrostomies, injections of alcohol and nerve resections for relief from pain, and ten unilateral ligations of the external carotid. Block dissections were discontinued owing to the high mortality (from 10 to 20 per cent). The operative risk was poor. Good results were obtained in checking the progress of disease temporarily by means of irradiation. Twenty-nine deaths were due to postoperative hemorrhage, and five were surgical deaths.

Blair, Brown and Womack [11] published the results of a study on 211 cases of carcinoma in and about the mouth. They classified these growths according to the site of the origin, and divided them into four groups according to their stage of evolution: (1) early, (2) medium, (3) advanced and (4) inoperable. They followed Broders' classification. They believe that biopsy is attended with some danger, and that cautery

9. Harmer, W. D.: Diathermy Operations for Cancer of the Tongue, Brit. J. Surg. **15**:661 (April) 1928.

10. Dorrance, G. M., and McShane, J. K.: Cancer of the Tongue and Floor of the Mouth, Ann. Surg. **88**:1007 (Dec.) 1928.

11. Blair, V. P.; Brown, J. B., and Womack, N. A.: Cancer in and About the Mouth: Study of Two Hundred Eleven Cases, Ann. Surg. **88**:705 (Oct.) 1928.

and irradiation diminish this danger. They have found many tumors with various degrees of differentiation at different points, and believe that many tumors may increase in virulence as time goes on. A condition in which cancer cells are found, but in which they do not break through the normal limits of the tissues, is described as precancerous. They confirm Broders' observations of the occurrence of metastasis in a greater percentage of cases in high grade malignant tumors. Their operative mortality was 21.5 per cent. They performed 189 major operations on 130 patients. In most cases the disease was advanced. In nineteen cases death was due to pulmonary involvement, in three to cardiac involvement, and in three to hemorrhage. In four cases in which the common or external carotid artery was ligated, two of the patients died from pneumonia. Sixty-six per cent of the patients in the early group they believe to be cured; 72.4 per cent of the patients in the medium group are still living, and 32 per cent of those in the advanced group are still living without recurrence of the condition. Forty-three of the patients with advanced disease, who were operated on, are still living. The percentage of those living without recurrence is greater in the group with low grade tumors than in the group with high grade tumors. The mortality was greater when the operation was performed in the posterior part of the mouth probably because of the increased danger of respiratory infection.

Quick [12] reported the results in 2,741 cases of carcinoma of the lip and mouth observed by him from 1917 to 1927. He considers irradiation as part of his surgical equipment. He believes the two should be associated and not opposed. He advocates prophylaxis of the mouth before any type of treatment. He uses external irradiation of maximal intensity, both to the primary lesion and to the lymph nodes. If the grade of the malignancy is low, external irradiation is not effective and he uses radium seeds. He does not believe there will be necrosis unless infection takes place. He resorts to surgical procedures only to remove bone if it is involved, to obtain access to the tumor if it is otherwise inaccessible, and to remove bulky fungous growths in order to hasten the effects of irradiation. In the latter type of case, he first inserts the radon in greater quantity than normally would be used, to compensate for what may be lost by the surgical removal of the greater part of the tumor soon after insertion. For the removal of the tumors, he uses a cutting cautery, but he believes that diathermy is just as efficient. He does not resort to block dissection as a routine measure, but always irradiates the neck bilaterally with maximal intensity. If a

12. Quick, D.: The Treatment of Cancer of Lip and Mouth, Am. J. Roentgenol. **21**:322 (April) 1929.

palpable lymph node is present, he performs a radical unilateral block, and then implants radon seeds in all suggestive areas. If the metastatic growths are inoperable, he merely implants the radon seeds. If the metastatic growth has perforated the capsule of the lymph node, he considers the node to be inoperable. Forty-nine per cent of his patients are dead, and 22 per cent have not been traced. Of 28 per cent who have been traced, 21 per cent (602) are clinically well. Two hundred and two of the 602 patients have been well from five to ten years; 124 have been well from three to five years; consequently, 11.8 per cent have been well for more than three years. Many of the patients who were not traced subsequently had been free from disease for three years. One hundred and five of 473 patients with carcinoma of the tongue are still well, 85 for more than three years.

Simmons [13] reported fourteen cases of adamantinoma, in two of which there was metastasis. Six patients were between the ages of 20 and 30 years, and six were more than 50; one was 13 and one was 73. Most of the tumors were in the lower jaw. The author reviewed the symptoms and histology of adamantinoma and concluded that its activity may vary considerably, as may its histologic appearance. He advocates radical resection of the portion of the jaw involved.

Falta [14] described five cases of endothelioma of the oral cavity. Three of these were in the hard palate, one was in the lower lip and one was in the upper alveolar border and upper lip. This observer makes a differential diagnosis between endothelioma and carcinoma. Endothelioma grows larger than carcinoma but does not ulcerate or metastasize. He believes that the microscopic examination proves the endotheliomatous nature of the tumor, and that it originates from blood and lymph vessels; also that it represents something halfway between epithelioma and sarcoma. The tumors were removed surgically in all cases, and recurrence was present in only one case. The time of observation is too short to permit conclusions to be drawn.

Pfahler [15] described his method of treatment by irradiation of carcinoma of the buccal cavity. He believes that he has secured 50 per cent of cures in this type of case, and that if the patients would present themselves earlier this average would be increased by 25 per cent. He believes that carcinoma of the mouth and lips will completely disappear when all disease and irritation of the mouth are eliminated. He described his treatment minutely. Of fifty-six patients with advanced metastasis

13. Simmons, C. C.: Adamantinoma, Ann. Surg. **88**:693 (Oct.) 1928.

14. Falta, L.: Ueber endotheliome der Mundhöhle, Wien klin. Wchnschr. **42**: 210 (Feb. 14) 1922.

15. Pfahler, G. E.: Pure Gamma Radiation in the Treatment of Carcinoma of the Buccal Cavity, Radiol. Rev. & Chicago M. Rec. **51**:93 (March) 1929.

that he treated in three years thirty-six are still living, twenty-three of whom are clinically cured and thirteen of whom are still under treatment.

LARYNX

Thomson [16] reported seventy cases of intrinsic carcinoma of the larynx treated by laryngofissure. He presented tables showing the sex and age distribution, and has noted that the younger patients are likely to be women. Thirty-four of his patients are still alive. The first one was operated on in 1900, and thirty-two of these have been well from three to nineteen years. He found that the resistance of women seems to be greater than that of men. Of seven women, five lived for four and a half years following operation. In two, there was recurrence. Thomson is very much in favor of laryngofissure whenever it is advisable, as the patients are able to lead a useful life following this operation and to maintain a good voice. Of the patients who died, eighteen died from causes other than carcinoma, and most of these had been free from recurrence for at least three years. Seven died from carcinoma in some other part of the body, usually in the neck, without any local recurrence. Metastasis appeared as late as seven years after the operation. Eleven died from local recurrence, eight of these within the first year. According to Thomson, the latter recurrences were due to incomplete removal. Three other patients died from recurrence after three years. There were three deaths following operation, one from the administration of heroin, one from bronchopneumonia and a third from rupture of the esophagus following vomiting. This author gives 76 per cent as his average of lasting cures.

MacKenzie [17] reported on his method of treatment of carcinoma of the pharynx, larynx and esophagus by means of surgical diathermy. He favors diathermy above surgery, because he believes that diathermy avoids the dissemination of malignant cells into the lymphatic vessels and into the surgical field, and at the same time sterilizes the field. He stated that the tonsils and surrounding areas are most frequently affected by malignant lesions, after which comes the base of the tongue, the soft palate, the hyoid fossa and the postcricoid region. He divided the cases into two groups: the eradicable and the ineradicable. The division depends on the site as well as the stage of the growth, but he treats patients with conditions that are very extensive. He believes that removal of lymph nodes should be undertaken in all cases. He considers the lymphatic node a nursery for carcinoma cells rather than a barrier.

16. Thomson, St. Clair: Intrinsic Cancer of the Larynx Operated on by Laryngofissure, Arch. Otolaryng. **8**:377 (Oct.) 1928.

17. MacKenzie, D.: The Treatment of Cancer of Pharynx, Larynx and Esophagus by Surgical Diathermy, Ann. Otol. Rhin. & Laryng. **38**:32 (March) 1929.

He gives a detailed description of his methods of treatment in the various cases. In cases of tonsillar malignancy, he first ligates the carotid, then shrinks all the enlarged nodes with the diathermy needle, and attempts to seal off the region between the neck and the pharynx with the diathermy. The primary growth is removed at a second stage. Whenever there is ulceration, he believes in coagulating the surface before starting on the removal of the primary growth. MacKenzie is a firm believer in contact infection, and coagulates all the tissues which are close to or in contact with the primary lesion. In malignant tumors of the epiglottis, he performs subhyoid pharyngotomy, usually with tracheotomy as a first stage. In malignant tumors of the introitus of the larynx, he also performs lateral pharyngotomy. In his cases, the mortality rate has been highest following this operation. In post-cricoid malignant growths, he does not hope to remove the malignant lesion as a rule, but aims only at reestablishing the ability to swallow. He has found that diathermy is of less use than radium in lympho-sarcoma. He presented twelve cases, including cases from each group, but did not give statistics.

Finzi and Harmer [18] reported their method of treatment by means of radium for intrinsic carcinoma of the larynx. They used this method in fifteen cases. They first make a window through the thyroid cartilage, without opening into the cavity, and insert needles externally to the growth under the edges of the cartilage. Tracheotomy is then performed, after the wound is closed, in order to avoid infection. Some infection occurred in all their cases, but it never was severe. Fourteen of their fifteen patients were men; the ages varied from 45 to 67 years. In eight of the patients the condition was in an early stage. Of these, six have been well from one to three years with almost complete return to a normal condition. There were five patients in whom the disease was advanced; one patient has been well for four years, one had recurrence after a year, one had stenosis following treatment and then recurrence, one did not improve and one died from the results of overdosage of chloroform narcosis. In two inoperable cases, one patient was well two and a half years and then had a recurrence, and one died after fifteen months from metastasis. If the condition is inoperable, roentgen treatment is given. The authors suggest that if the radium has no effect, one can always resort to laryngectomy.

Portmann [19] advised the subperichondral resection of the thyroid cartilage without perforating into the cavity, in order to apply radium in plaques to carcinoma of the larynx a week later.

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18. Finzi, N. S., and Harmer, D.: Radium Treatment of Intrinsic Cancer of the Larynx, Brit. M. J. **2**:886 (Nov. 17) 1928.

19. Portmann, Georges: L'aide chirurgicale dans le traitement radiothérapique du cancer du larynx, Acta oto-laryng. **12**:351, 1928.

Mackenty [20] reported 700 cases of carcinoma of the larynx since 1908. He divided laryngeal malignant lesions into extrinsic, intrinsic and borderline intrinsic groups and described the symptoms to which each group gives rise, as well as the treatment. He advises laryngectomy, as against laryngotomy, and prefers a single-stage operation. He advises thorough and prolonged preoperative preparation, including gastro-intestinal and oral hygiene. He uses both local and general anesthesia. In performing tracheotomy, he corks off the trachea carefully so as to avoid infection and the dropping of foreign material into the lungs. He performed 230 operations with a death rate of 3 per cent. In early cases, he found that recurrences were 3 per cent if laryngectomy was done, and 35 per cent if thyrotomy was done. In the moderately advanced cases, recurrences were 25 per cent and in the borderline extrinsic cases, 35 per cent. In extrinsic cases, recurrences were almost 100 per cent, but in two cases of carcinoma of the epiglottis the patients have been well for two years. This author believes that carcinoma is increasing, especially in young persons.

New [21] described a method for the removal of the larynx in two stages. He considers that the primary object of laryngectomy is the complete removal of the malignant lesion and the protection of the patient from reaction. He also prefers a type of tracheotomy which does not necessitate the use of a tube. The two-stage operation devised by him avoids the necessity of constant postoperative care, of drainage, of irrigation and the disadvantage of stricture of the trachea. In three years from 1925 to 1927, 175 patients suffering from carcinoma of the larynx were seen at the Mayo Clinic, and on sixty-four of these, operations were performed: seventeen thyrotomies, forty-two laryngectomies and five explorations. A Rehfuss tube is inserted for feeding, before the first stage, local anesthesia being used for this stage. From below the tip of the chin to above the manubrium a median line incision is made. The hyoid bone is exposed and divided in the median line, the muscles and the isthmus of the thyroid gland are divided, and the larynx and the upper two rings of the trachea are carefully skeletonized up to the lateroposterior margins of the larynx. The skin is then sutured to the second tracheal ring, leaving the upper part of the trachea exposed, and the remainder of the wound is sutured. The trachea is not opened. Four or five days later, when the temperature has returned to normal, a small disk is removed from the trachea. The resulting infection of the wound creates a barrier to the spread of infection.

20. Mackenty, J. E.: Laryngeal Cancer; Early Diagnosis and Treatment, Arch. Otolaryng. **9**:237 (March) 1929.

21. New, G. B.: Two-Stage Laryngectomy, Surg. Gynec. Obst. **47**:826 (Dec.) 1928.

Four days later, when the temperature is again normal, the removal of the larynx takes place under paravertebral block anesthesia, together with superficial cervical block. The larynx is dissected from below upward. The pharyngeal opening is closed with two rows of continuous sutures of chromic catgut. The edges of the skin are pared, and the skin is sutured to the margin of the trachea with silk. The wound is completely closed. A small, split rubber drain is placed in the lower part of the wound, under the tracheotomy tube, after both stages. The advantages of this method are: (1) absence of excessive reaction; (2) rarity of pharyngeal fistula; (3) absence of serious infection and (4) noncontracting tracheotomy. Of sixty-four patients with malignant lesions of the larynx, on whom operation was performed, three died following the first stage laryngectomy, one from paralysis of the esophagus, due to the infiltration being brought too far back, with pneumona due to aspiration. The other two patients also died from bronchopneumonia; they were poor surgical risks.

New and Figi [22] reported two cases of carcinoma of the larynx, one in a boy, aged 15 years, the other in a woman, aged 24 years. In both cases the growths were so extensive as to necessitate two-stage laryngectomy. The condition of the patients eight and ten months following the operations was satisfactory. Of 380 cases of carcinoma of the larynx observed at the clinic in ten years, only 5 per cent occurred in patients aged less than 40 years. Statistics of other observers are cited, and the differential diagnosis is considered.

Brémond and Bonnet [23] reported a case of carcinoma of the larynx in a girl, aged 14 years, which involved the right arytenoid and vocal cord, as well as the anterior commissure. Laryngectomy was performed, which was followed by a recurrence three months later, and eventually the patient died.

Sercer [24] reported fourteen cases in which laryngectomy was performed by a new method. Up to 1926, the author had performed forty operations on laryngeal malignant lesions. Since then he had operated in fourteen cases with his new method. He does a block excision of the lymph nodes in all his cases. He has had two deaths following operation in his second group of cases. One of these was due to erysipelas; the other was due to tonsillitis with pyemia. He advises operation, even in those cases in which metastasis is present. He makes a horseshoe incision of the skin with an upper base, and per-

22. New, G. B., and Figi, F. A.: Carcinoma of the Larynx in the Young, Arch. Otolaryng. **9**:386 (April) 1929.

23. Brémond, M., and Bonnet, P.: Un cas de cancer du larynx chez une fillette de 14 ans, Arch. internat. de laryngol. **34**:1014 (Sept.-Oct.) 1928.

24. Sercer, A.: Considérations sur les différentes techniques de la laryngectomie, Rev. de laryngol. **49**:67 (Feb.) 1928.

forms pharyngotomy and laryngectomy at the first stage. At the second stage, ten days after the first operation, he closes the pharyngotomy opening. He also does a plastic operation on the skin in order to suture it to the trachea without tension. He does not use a tube, as the healing of the tracheotomy is by first intention.

Kahler [25] upholds the present trend to more conservative operation in malignant lesions of the larynx. He cited the statistics of many observers to show that recurrences in cases of thyrotomy are continually diminishing. It is his belief that the safest way to perform thyrotomy is to remove the cartilage underlying the tumor as well as the tumor itself. He advises diathermy whenever possible in order to avoid the spreading of cells, but he believes that it increases the danger of perichondritis. He believes that even if laryngectomy is indicated but is refused, thyrotomy will give years of useful life to the patient; he cited two of his own cases, in one of which the patient has been well for eight years, and in the other for seven years.

Tempea and Gilbuzoianu [26] reported five cases of papillomatosis of the larynx. They made an exhaustive study of the history of papillomatosis and its treatment. The etiology was considered, but a definite conclusion was not reached. They favor deep roentgen treatment, which is harmless and not painful and which acts rapidly and permanently. In the treatment of adults, they combine operation with the application of roentgen rays, as this shortens the period of treatment. They do not give the end-results in their cases, as the patients have not been under observation long enough. They believe that irradiation must be of sufficient dosage, as otherwise it acts only as an irritant.

Dahmann [27] reported his experiments in the treatment of papillomatosis. He has experimented in the use of diathermy on pieces of flesh cut to resemble papillomas, as well as on natural papillomas of the tongue. He concluded that surgical intervention is the most favorable treatment for papillomatosis, whether or not it is followed by the application of nitric acid. To use this in the larynx, he has devised a special instrument consisting of a tube with an asbestos ball at the end of a plunger, which is dipped into the nitric acid, with a sucker to remove the excess fumes. If diathermy is used, he believes that the unipolar type should be the one chosen, as it limits the area of action. He is opposed to irradiation and open operations.

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25. Kahler, Otto: Erweiterte Thyreotomie bei Karzinom, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **122**:151, 1929.

26. Tempea, V., and Gilbuzoianu: Contribution clinique à la papillomatose laryngienne, Ann. d. mal. de l'oreille, du larynx **47**:1112 (Dec.) 1928.

27. Dahmann, H.: Sistematische Versuche zur Therapie der Papillomatose, Ztschr. f. Laryngol., Rhinol. **17**:362 (Jan.) 1929.

Runge [28] has an apparatus, similar to the one mentioned in the foregoing report, made of glass containing a platiniridium wire to which cotton can be attached. Only the middle portion of the cotton is moistened with the acid, and it is then drawn back into the tube so that the dry cotton shuts it off. The applicator is then applied to the papilloma. The patient takes a deep breath and expires slowly, and during the expiration the cotton is pushed out and the cauterization performed. The treatment of papillomas of the larynx in children is considered, and the use of roentgen rays in very small dosage is advised. In adults, Runge has used roentgen rays with some effect, but advises surgical procedures followed by the use of nitric acid and roentgen rays.

Thrane,[29] on the other hand, advised roentgen treatment. He stated that roentgen rays in the treatment for laryngeal cases had fallen into disrepute on account of the many unpleasant complications following its early indiscriminate use. A small dose is sufficient and harmless, and if necessary it can be repeated later. He cited the case of a boy who had had four operations for papillomas. Ten days after the first application of roentgen rays, the tracheal tube was removed and nine months later the larynx was completely normal and he had no recurrences after three years. Thrane stated that it is necessary to use very small doses and to be patient, as the effect will extend over many months. One man, aged 27 years, did not show any effect from the treatment until ten months after it had been given, and then he was completely cured.

Holmgren [30] reported three cases of tracheal carcinoma, all in women, two aged 62 years and one aged 45 years. As a rule, tracheal carcinoma is extremely rare, but is more common in men than in women. In these three cases the disease was in the anterior wall, in the upper third of the trachea. Holmgren first removed the tumors with diathermy or with the knife, and then used radium.

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28. Runge, H. G.: Zur Therapie der Kehlkopfpapillomatose, Ztschr. f. Laryngol., Rhinol. **17**:377 (Jan.) 1929.

29. Thrane, K.: Kasuistiseher Beitrag zur Behandlung der Larynxpapillome, Ztschr. f. Laryngol., Rhinol. **17**:384 (Jan.) 1929.

30. Holmgren, Gunnar: Zur Kasuistik der primären Trachealkarzinome, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **122**:145, 1929.

Abstracts from Current Literature

Ear

Osteogenesis Imperfecta Congenita of Labyrinth of Ear. M. Weber, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:345 (Feb. 24) 1930.

Weber discusses the occurrence of osteogenesis in an infant 2 days of age. The endosteal capsule consisted of a thin layer of pathologically differentiated fibrillar bone. The enchondral capsule contained chiefly medullary substance. There were many fragments of cartilage surrounded by deposits of altered fibrillar bone, which was variously noted as a transitional form between osteoid and chondroid tissue. Lamellar bone was not found; neither was there evidence of osteoclasts. The periosteal capsule consisted throughout of the pathologically differentiated fibrillar bone appearing consolidated toward the enchondral capsule, as there was no breaking down of tissue. The origin of these transformations lies in a generalized fetal inhibition of development leading to abnormal differentiation of the entire skeletal system with deviation to the left of the bony structures. The author points to his previous papers on the subject.

Melanotic Tumors of the Ear. H. Barth, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:369 (Feb. 24) 1930.

Barth described the occurrence of melanotic tumors in a man, aged 47, in whom a small wartlike tumor developed about one year previous to his admission at the clinic. The patient had previously consulted a specialist, who had repeatedly removed new growth of the tumor, which had been pronounced to be nonmalignant. The left auditory canal was filled by grayish-black granulations which extended over the auricle. Below the canal there was an abscess containing necrotic masses. The parotid gland seemed enlarged. Microscopic examination now pointed toward the diagnosis of a progressing melanoma. Operation was no longer feasible owing to the extent of the tumor, and the patient was submitted to radium therapy. He returned to the clinic, one month after the last treatment had been given, suffering from severe facial pain and swelling of the entire face. Fetid pus was discharged, and the suppuration continued up to the time of the patient's death three weeks later. Physical examination had disclosed a marked enlargement of the liver coincident with enlarged supraclavicular and inguinal lymph nodes. An empyema had developed, and there was marked edema of the legs. On the basis of a review of the literature and a discussion of the results of microscopic examination of the ear and surrounding portions of the temporal bone, the author points to the importance of early recognition of this rare disease and appropriate treatment. Nevi in the auditory canal or on the auricle should be removed unless this treatment involves too extensive operation. The patient should invariably be kept under observation. The value of irradiation in this rare disease has not been determined.

Purulent Diseases of the Petrous Part of the Temporal Bone. H. Brunner, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:383 (Feb. 24) 1930.

On the basis of a review of the literature and his personal observation of three patients, the clinical histories of two of whom are described, Brunner concludes that various types of purulent otitis media may lead to involvement of the petrous portion of the temporal bone, whereas in the literature acute mucosis otitis is chiefly held responsible for this complication. In one case an acute exacerbated cholesteatoma could be incriminated; in the other, tuberculosis. The third case,

which had been reported in a previous paper, pertained to a patient with diabetes in whom subacute otitis media had developed. Brunner states that pneumatization of the bone is not essential, although collection of pus is favored by such a condition. The danger of this accumulation lies in the fact that the dura is easily permeable, which leads to meningitis. The topographic relation between the nervus abducens, the nervus trigeminus and the sinus cavernosus is of especial interest, although, according to the author, paralysis of the nervus abducens does not always indicate a suppuration, or can it be taken as a guide for prognosis or therapy. Trigeminal symptoms are of greater importance, and it is especially neuralgia that points to involvement of the anterior pyramidal tract in the region of the gasserian ganglion. However, absence of neuralgia does not exclude a disease of the part. Brunner directs attention to otogenic phlebitis of the sinus cavernosus which has as yet not been fully investigated, although Gradenigo has pointed toward the involvement. Infection of the veins of the plexus through the auditory tube leading to sinus thrombosis is of more frequent occurrence than has been believed heretofore, and prognosis of such complications is unfavorable especially in patients with a lowered general resistance, which was the case in Brunner's personal cases. However, perilabyrinthal processes have a tendency toward spontaneous resorption, especially if the antrum has been opened to relieve the tension in the perilabyrinthal cells. It is dangerous to operate if the abscess has spontaneously opened into the auditory tube.

ACUTE OTITIS MEDIA AND PNEUMATIZATION OF MASTOID PROCESS. W. HANSE, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:424 (Feb. 24) 1930.

On the basis of roentgen examinations of 500 patients with acute otitis media, Hanse concludes that good pneumatization is almost invariably indicative of an acute condition, whereas in lack of pneumatization a chronic disease persists. Hanse found this occurrence only five times in his patients. Examination disclosed that three of them had previously had ear trouble; in one child, aged 8, discharge from the ear occurred intermittently for four years. Another child, aged 7, three years previously had had measles and whooping cough with suppuration from both ears as a complication.

MECHANISM OF DEVELOPMENT OF AUDITORY ORGAN IN FROGS. G. JUNG, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:527 (March 25) 1930.

Jung made a number of experiments on larvae of *Rana fusca, Hyla arborea* and *Rana esculenta,* repeating some of those that previous authors had done for study of the relation between the middle ear and the labyrinth. Of especial interest was the behavior of the nervus acousticus in regard to unilateral removal of the labyrinth; likewise, the problem of origin of the cartilaginous labyrinth capsula and the regenerative capacity of the auditory bulb. Although more than 100 animals were used, several died, so that in all, 72 were embedded and cut in serial section for microscopic examination. Puncture of the membrane of the ear labyrinth in *Rana fusca* does not inhibit its future development. Transplantation of the ear bulb into the orbit in *Rana fusca* in any stage of metamorphosis results in formation of a cartilaginous capsule even if the membranous labyrinth is further developed. With unilateral removal of the labyrinth in *Rana fusca* and *Hyla arborea,* the inner ear is not regenerated, neither does formation of the cartilaginous capsule, the operculum or the pars interna plectri occur. However, at an early stage symptoms of vestibular deficiency are observed, as shown by the fact that the tadpoles are seen swimming in circles around the longitudinal axis in the direction of the side on which operation was performed. The eye gradually moves caudalward, corresponding to the lower resistance of the tissue. The cartilage of the middle ear, the pars media et externa plectri and also the annulus tympanicus are not inhibited in their development. In all these experiments with unilateral removal of the labyrinth, the stage of larval development is immaterial. Soon after simple removal of the branchia with the underlying mesenchyma, complete regeneration occurs. The

development of the middle ear is in no way influenced by this operation. Therefore, one may infer that the mesenchyma of this region is differentiated at a late stage to cartilage. The inner ear is likewise not touched by removal of the branchia. If the auditory bulb is removed, however, together with the branchia on one side, there is no new formation of a labyrinth although the development of the middle ear is normal. These experimental results conform to conditions observed in the human ear. A normal middle and external ear are noted with deformed or absent labyrinth and vice versa.

NEW METHOD FOR TESTING ACUITY WITH SPEECH SOUNDS. H. SELL, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:571 (March 25) 1930.

Sell devised an apparatus which assures greater freedom from overtones than previous audiometers have had. The author's reception microphone is superior to the one devised by the Western Electric Company. Sell discusses the functioning of his audiometer and points to its diagnostic value for distinguishing between deafness due to involvement of the middle ear and deafness on a nervous basis. The results of his experiments will be published at a later date.

EDITOR'S ABSTRACTS.

Pharynx

MODERN ASPECT OF ANATOMY OF TONSILS IN RELATION TO GERMINAL CENTERS AND LYMPHOCYTES. K. A. HEIBERG, Folia oto-laryng. **19**:209 (March) 1930.

The surface of the tonsils is not indicative of their pathologic condition according to Heiberg. It is only by microscopic examination of the adenoid tissue that the severity of infection of the organism may be inferred and a guide in prognosis found. The centers of phagocytic activities (or germinal centers) especially show variations of structure which have been found to correspond to the degree of involvement. They are larger in the healthy organism pointing to a metabolic relation. The author refers to his previous papers on this subject. On the basis of a study of 100 cases obtained from operations done at the Finsen Institute, Heiberg does not find any difference in the behavior of pharyngeal and palatine tonsils. The activity of the germinal centers, according to Heiberg, appears to lie in the direction of destruction of lymphocytes, whereas production of the latter takes place in other parts of the tissue. The lymphocyte cap surmounting the germinal centers is larger if these are defective, and several distinct types may be distinguished in their organization. The structure of the lymphocytic nuclei is more highly differentiated in the adenoid tissue than in the lymphocytes of the blood or in those seen in infiltrations surrounding the blood vessels in acute inflammations. Greater development of the interstitial tissue is found in infections. However, the rôle of immunity and metabolism is not clearly defined as yet. Heiberg points to the substance which was isolated by von Schmidt in 1927, from the germinal centers of the tonsils. It was found to be thermostabile in acids after removal of the proteins and caused lymphopenia after subcutaneous injection. Stimulation of the tonsils by "massage" has likewise caused lymphopenia.

EDITOR'S ABSTRACT.

Larynx

DEPOSIT OF LIPOIDS IN LARYNX AND TRACHEA. N. LEBEDEVA, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:518 (March 25) 1930.

Lipoid deposits are noted in the fibro-elastic tissue in old age and are characteristic of atherosclerotic degeneration of the arteries. Lebedeva studied material obtained from forty-two necropsies on patients ranging from 5 months to 80

years of age. Twenty-eight patients had been more than 40 years of age. As a result of his extensive microscopic examinations, the author concludes that the deposit of fat and lipoid substances occurs on the walls of the larynx and trachea in the form of diffuse fatty degeneration of the fibro-elastic tissue, also as accumulation of lipoids in the mucous glands, in the cartilage cells and in the migratory cells of the connective tissue. The diffuse fatty degeneration begins in patients between the ages of 25 and 30 years; it is always present around the age of 40 and above. With the exception of the epiglottis, it was noted in the perichondrium of all cartilages and is increasingly distinct with age. In the ligamentum cricothyreoideum and less often in the longitudinal elastic fibers of the mucosa of the larynx, lipoid substances are likewise observed, but never in the fibro-elastic tissue of the vocal cords. According to Lebedeva, the accumulation of lipoids in the mucous glands of the larynx and the trachea is a result of certain secretions which occur especially with progressing age in these places. They are independent of the deposits in the fibro-elastic tissue of the larynx and trachea. There may be a relation between the lipoid secretion of the cells in the upper respiratory tract and the lipoid metabolism of the entire organism. Deposits of fat in the cartilage cells of the larynx and trachea are not related to lipoid deposits in any other structural elements of these organs and are constantly observed with very minor quantitative variations. The cartilage cells of the epiglottis do not contain fat drops.

FUNCTION OF HUMAN LARYNGEAL MUSCULAR APPARATUS. K. M. MENZEL, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:555 (March 25) 1930.

Menzel points out that our previous knowledge has been obtained through animal experiments, as heretofore no harmless method of temporarily paralyzing the muscles has been known. From his study of the problem, he concludes, however, that procaine hydrochloride does have such an action. He describes its effect and the results of its use in four patients in whom various operations were done. The effect of injection of procaine hydrochloride was likewise studied on fresh corpses. As a rule, from seven to ten minutes after intramuscular injection of a 2 per cent procaine hydrochloride solution complete paralysis of the musculus crico-arytaenoideus posterior occurs resulting in immobilization of the vocal cord during phonation and respiration almost in the median line with a straight edge. As a result of his experiments on ten persons, the author states that with exclusion of both interarytenoid muscles there is likewise inhibition of the gliding motion of both arytenoid cartilages toward the median line without apparent marked inhibition of function. Future experiments in this direction may lead to better comprehension of physiology and pathology of the larynx.

EDITOR'S ABSTRACTS.

Nose

POSTOPERATIVE TAMPONADE OF MAXILLARY SINUS. E. KRONENBERG, Folia oto-laryng. **19**:217 (March) 1930.

After consideration of the postoperative treatment of the maxillary sinus on the basis of his personal experience and the results reported in the literature, Kronenberg concludes that tamponade after operations done according to the methods of Denker or Luc-Caldwell should be discontinued.

GRANULOMA PEDICULATUM OF THE VESTIBULE OF THE NOSE (CONTRIBUTION TO STUDY OF SO-CALLED HUMAN FORM OF BOTRYOMYCOSIS). C. KRUMBEIN, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:431 (Feb. 24) 1930.

In Krumbein's patient, a peasant girl, aged 15, the condition developed consequent to her caring for a motherless young lamb which had been purchased

from a passing shepherd three weeks previously. Bacteriologic examination of a lesion on its nose disclosed a pure culture of *Staphylococcus pyogenes aureus* which was identical with that isolated from the patient. Microscopic examination of the lesion revealed its similarity to the microscopic examination of the infected human nasal tissue. There were no indications pointing toward a specificity of the so-called "human botryomycosis," and *Staphylococcus pyogenes aureus* was clearly the infective agent. The fact that cutaneous infections with this bacillus do not invariably lead to the development of granuloma pediculatum may be explained by the animal passage having modified certain specific characters.

Is the Continuity of Nerve Trunks Entering the Ganglion Sphenopalatinum Interrupted or Not? K. Vogel, Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:485 (March 25) 1930.

On the basis of a discussion of the literature and after careful consideration of three specimens of which microscopic serial sections were done, Vogel comes to the following conclusions: The nervus canalis pterygoidei (vidian) is completely interrupted. Only a few fibers of the sphenopalatine nerve pass into the ganglion; the greater part reaches in front and laterally beyond the ganglion, and together with the nerve fibers originating from the ganglion, forms the palatine nerves. The nervus palatinus major is chiefly composed of fibers which originate from the second branch of the trigeminal nerve and are not interrupted in the ganglion. A few fibers on the posterior side are derived from the ganglion. The bundle of nervi palatini minores consists partly of fibers from the second trigeminal branch; its remaining fibers are derived from the ganglion. There are from about ten to twelve nerve branches originating from the ganglion which reach toward the nasal cavity. One of the largest of these is the nervus nasopalatinus scarpae which supplies the nasal septum. All nerves of the nose leading to the posterior and superior part of the nasal cavity and to the roof of the nasal pharynx as well as to the nasal septum originate from the ganglion. Whereas the nervus nasopalatinus contains only fibers derived from the ganglion, the nerve trunk supplying the middle and lower turbinals also contains fibers originating from the second branch of the nervus trigeminus. A number of small nerves arising from the ganglion sphenopalatinum reach through the fissura orbitalis inferior into the orbit. They anastomose with the first branch of the nervus trigeminus and form small groups of ganglion cells. They do not contain any fibers from the second trigeminal nerve. The blood vessels reaching from the pterypoid fossa to the nasal cavity are solely innervated by the ganglion sphenopalatinum and to a small extent directly by the nervus trigeminus.

Editor's Abstracts.

Miscellaneous

Conservative Treatment in Difficult Decannulation in Children. Runge, Ztschr. f. Hals-, Nasen- u. Ohrenh. **24**:576, 1929. (From the Transactions of the German Otolaryngological Congress.)

In very young children, who for various reasons are wearing a trachea tube which cannot be removed safely, instead of proceeding to operative intervention, the author recommends awaiting the growth of the diameter of the trachea. The tube is not removed until the child is able to breathe easily day and night for three days with the tube closed. The parents are informed that the waiting period may be from one to one and a half years. Ten cases are reported, with one death early in the author's experience, which Runge attributes to insufficient observation before the removal of the tube.

Detailed description of the various conditions producing obstruction, which for a time contraindicated removal of the tube, is given.

THE SIGNIFICANCE OF "RHESEASTHENIA" IN THE PRACTICE OF LARYNGOLOGY. SOKOLOWSKY, Ztschr. f. Hals-, Nasen- u. Ohrenh. **24**:593, 1929. (From the Transactions of the German Otolaryngological Congress.)

By this term the author means the phono-asthenia of public speakers, etc., and he calls attention to its frequency in persons of many pursuits, such as sales people, mothers with refractory children, correspondents who dictate much, "the rheseasthenia of daily life," those who are much more frequently seen in the practice of laryngologists. In such cases topical applications alone are useless, the only real cure lying in proper use of the voice. The patient must be taught not to speak louder, but to enunciate better. Briefly he must use the throat and voice less and the lips more. A few simple exercises are described as sufficient. For instance the patient must observe that he opens his mouth for *a* and *ah*, and that he puckers his lips forward for *o* and *u*.

LEWY, Chicago.

Society Transactions

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OTOLARYNGOLOGY

H. P. Schenck, M.D., *Reporter*

Jan. 15, 1930

George M. Coates, M.D., *Chairman*

Observations on the Transillumination of the Frontal Sinuses. Dr. Edward H. Campbell.

This article will appear in a later issue.

DISCUSSION

Dr. Samuel R. Skillern, Jr.: I have never observed the spot which Dr. Campbell refers to on the opposite side. Transillumination of the frontal sinus may fail due to infected supra-orbital cells. Polyps or pus in infected supra-orbital cells prevent transmission of light in the case of a perfectly healthy frontal sinus. Transillumination of a diseased sinus by diffused light under the soft tissues is possible. Roentgenograms are superior to transillumination. If the roentgenogram disagrees with your diagnosis, however, it is probably wrong. With symptoms of frontal sinus disease and transillumination indicating a black frontal sinus, frontal sinus disease exists even if the sinuses are negative by roentgen examination. In one case with symptoms of right frontal sinus involvement, we desired to do a radical operation. Two roentgenologists, independently, reported absence of the right frontal sinus. I put a probe in the right frontal sinus and Dr. Widmann took plates showing the probe in the sinus. At operation the bone was found to be ½ inch (1.27 cm.) thick.

Dr. Stout: We get too close to the nose when we transilluminate. I think that this is what we see. I never remember seeing light go through to the opposite side if we go out far enough from the midline.

Dr. E. H. Campbell: I do not think that there is any question about this light going through. The combined thickness of the septum and the lateral wall of the nose is greater than that of the frontal septum and the inferior wall of the frontal sinus. The thickness of the skin and the subcutaneous tissues over the forehead is several times thicker than similar structures in the orbital area. This method is not infallible. I do not believe that the ethmoidal cell mentioned by Dr. Skillern is a factor in this transmission of light.

Dr. Warren B. Davis: The illustrations Dr. Campbell has presented speak for themselves. They are anatomic facts. The reason he gets these results is because of the type of transilluminator he uses. It has no lateral radiation and therefore should pass through the structures as he describes. I have not used that type of transilluminator and therefore do not feel qualified to discuss it.

Some Practical Points in the Use of Electrosurgical Measures in the Upper Respiratory Tract. Dr. Marshall B. Sponsler.

After reviewing the use of high frequency electric currents during the past twenty years, Dr. Sponsler emphasized the purposes to which the three modalities in use at present are best adapted. In the treatment for conditions of the nose and throat, the d'Arsonval current is used, with a large or indifferent electrode, placed over the middorsal region, and a small active electrode, varying from the

size of a large darning needle to that of a small sewing needle. The small electrode, inserted into the tissue for a distance of ¼ inch (0.64 cm.), causes the tissue to coagulate to a greater or lesser depth, depending on the strength of the current and the length of time of application. Cutting is accomplished with a current the to and fro movements of which are as many as 3,000,000 per second. The cut surface of this divided tissue appears seared and wounds of this sort, when sutured, heal by first intention.

The small electrode may be merely a tip or loop-shaped, the latter being useful in removal of bits of tissue for diagnosis. The combination of snare and cutting or coagulating current is of advantage in removing very vascular growths in the nasal cavity.

The proper setting of the machine is important and a foot switch is necessary so that the current is under control of the operator at all times. Small growths and superficial lesions of the nose and throat may be anesthetized with 10 per cent cocaine solution or 1 per cent procaine hydrochloride solution. Larger growths involving deeper structures demand general anesthesia. Gas or chloroform should be used rather than ether, which is inflammable.

For tonsil destruction the machine should be so set that a snow white circle of coagulation with a diameter of ¼ inch is produced with one second application of the current. Longer application produces charring and a sparking effect. When mucous membrane is coagulated, considerable charring with hyperemia and edema results. The mucosa of the nose is very sensitive while the tonsils are least sensitive, in some instances application being possible without a local anesthetic.

Secondary hemorrhage may be serious when coagulating lesions in the vicinity of larger blood vessels and proper ligation should be advised. Other untoward results are due to faulty technic as: (1) accidental contact of the active electrode with other parts than those treated, and (2) faulty contact of the indifferent electrode resulting in burns.

After electrocoagulation of the tonsils, there is not sufficient pain to cause the patient to refrain from eating, and none complained of any feeling of illness. There is practically no pain during the treatment, and while pain occurs during the two or three days following a seance, in about one fourth of the cases no pain or discomfort was noticed. Pain in the ear on the side of application appears almost constantly when one is treating in the region of the capsule in the middle of the tonsillar fossa and the upper pole. No bleeding appeared during any of the treatments but occurred twice in the same patient five days after coagulation. This was not of a serious nature. There is no evidence of toxemia after such treatments. The tonsillar fossae, in which the tonsils so far have apparently been removed, present a smooth surface, covered with epithelium, with no evidence of dense, white scar tissue. The healed area is soft and pliable. Since an average of eighteen treatments was given each patient, it is a time-consuming method for patient and physician.

DISCUSSION

DR. GEORGE B. WOOD: I have been interested in trying out fulguration in tonsillar tabs and small tonsils. The lack of discomfort is noteworthy, in contrast to the results after the actual cautery. The fulguration method coagulates and desiccates. I am disappointed that the method does not destroy the tonsil as fast as one would expect. I am told that fulguration is easier to control in inexperienced hands than electrocoagulation.

DR. FIELDING O. LEWIS: I believe that this method is indispensable in cancer work. It is useful when part of the tongue or like structures must be removed. We should always be equipped by cutting current as well as by the electrocautery, in case the extent of the cancer is more than we supposed. I agree with Dr. Sponsler that it does not replace surgical methods but is useful when contra-indications to surgical intervention exist, such as bleeders or patients fearful of surgery. In cases in which we have used the method, the final results were satisfactory.

DR. S. R. SKILLERN: Two years ago I bought a machine, and I have used it in thirty-eight cases. Everything Dr. Sponsler has said is true. I want to emphasize one thing, which I feel should not be overlooked. If the time between the treatments is lengthened for any cause, the anterior and posterior pillars have a trick of closing across the tonsillar fossa. In one case the tonsillar fossa had almost closed over a large piece of tonsil, and free pus could be expressed on pressure. The patient had had systemic symptoms of a focus of infection for ten days. The removal of tonsil tissue by electrocoagulation is more difficult than by the surgical method. The methods have been misrepresented by osteopaths, naprapaths and others and there will be a good many ruined throats. We will see pillars grown across and foci underneath. After sufficient tonsil tissue is removed, the residual tissue slips behind the anterior pillar. In coagulating this tissue it is easy to slip through to the anterior pillar and then tremendous edema with pain and reaction follows. This is due merely to touching muscle tissue. If the uvula is touched it gets as big as two thumbs. The sale of these machines should be restricted so that they do not fall into the hands of the unscrupulous.

DR. GEORGE M. COATES: In 1915, Leslie Mulford and I tried a fulguration machine on cases not suitable for surgical intervention. We attempted only surface coagulation. Two years ago I tried the method used by Dillinger. In the cases that I have used it in recently, there is an uncertainty as to the completeness of tissue removal. The electrotherapeutists remove tonsils in one or two sittings. In three of these, my hospital assistant has been called in to stop hemorrhage. It is difficult to stop hemorrhage from this source. I have been told that pillars do grow over infected tonsil tissue in these cases, and when this occurs, the condition is worse than it was before.

DR. SPONSLER: Medical opinion kept me from trying this method earlier. Novak of Boston reported a case several years ago, in which repeated examinations by capable otolaryngologists failed to reveal residual tonsil tissue in such a case, because contraction of the pillars had occurred after coagulation. I do not know that there is an inclusion of tonsil tissue, but I can see that it would be difficult to discern this tissue. At first the Germans and French tried to take out a whole tonsil at a sitting. This was a system of coagulate and curet, until the capsule of the tonsil was reached. This method, of course, should be discarded. Two years ago, I saw a woman who had had her tonsils removed at one sitting. A small tab remained. She had had so much bleeding that she had been in bed for a week. I later had no difficulty in removing the tabs, so that she could not have been a bleeder.

TWO CASES OF ABSCESS OF THE BRAIN PRESENTING SOME INTERESTING FEATURES. DR. AUSTIN T. SMITH.

The first patient, a man, aged 33, had had acute otitis media, which had cleared up promptly after myringotomy. A few weeks later, the patient became dull, lethargic and stuporous. Pain centered over the right frontal area. At this time there was no evidence of mastoid disease, the temperature was normal and the pulse rate was slow. There were 74 cells per cubic centimeter of spinal fluid, 93 per cent being lymphocytes and 7 per cent polymorphonuclears. Neurologic opinion favored the diagnosis of encephalitis, and the patient was treated on this basis for four weeks, during which time a low grade neuritis developed on both sides but was more marked on the left. Pain was persistent over the frontal region. During the sixth week, weakness of the right third nerve and of the left seventh nerve was noted. The eyegrounds showed optic neuritis with hemorrhage. There was a swelling of 1½ diopters on the right and 3 diopters on the left. The right mastoid area was opened but the cells gave no evidence of inflammatory change, and the inner table was intact. An opening in the inner table was made but no lesion was discovered beneath. Forty-eight hours later, weakness of the left arm and leg without spasticity or clonus was noted and the patient became stuporous. The right temporoparietal region was exposed and

the temporal lobe explored with a needle. A very large abscess was found, and a large quantity of pus was aspirated. A type IV pneumococcus was isolated in cultures. The patient died ten hours after operation, although he had improved markedly immediately after the removal of the pus. Few cases have been reported in which healing had occurred, and the perforation of the tympanic membrane had closed prior to the onset of other symptoms.

The second patient, a coal miner, aged 29, had had "catarrh" of the nose since childhood, and polypi had been removed from his nose on several occasions. While otherwise in good health, pain had appeared over the left side of the forehead, usually in the morning and lasting a few hours. As the pain was increasing in severity, and redness and swelling appeared over the left frontal and temporal areas and over the upper eyelid, the patient was admitted to the hospital. At this time the temperature was 102 F., with a pulse rate of 100, and respirations of 20. The neurologic observations were completely negative. Infection of both frontal sinuses and both ethmoidal sinuses was reported by the roentgenologist. A radical Killian operation on the left frontal sinus revealed foul smelling pus in the sinus. The lumen was filled with polypoid tissue and hyperplastic membrane. A communication with the right frontal sinus revealed a similar condition there. Both frontal and both ethmoidal sinuses were exenterated, and free drainage was established into the nose. The inner table of the frontal bone was intact. Improvement followed the operation but later symptoms of bronchopneumonia appeared and death ensued seven days after operation. Postmortem examination revealed a large abscess occupying the whole of the anterior portion of the left temporal lobe. The dura was densely adherent to the skull in the frontal region but there was no evidence of inflammation on its inner surface. At the base, in the left middle fossa, small areas of the dura were inflamed and necrotic. No suppurative tract led to the sinuses and there was grossly no evidence of the path of infection from the sinuses to the brain. When the sphenoidal sinuses were opened, they were found to contain pus. Because of the close relationship of the anterior part of the temporal lobes to the sphenoid bones, it is likely that the infection of the brain came from this source, probably by means of a retrograde thrombophlebitis.

DISCUSSION

DR. FRANCIS C. GRANT: I have great diffidence in discussing brain abscess because I have great sympathy for the difficulty of diagnosing these lesions. In the cases in which an attempt is made to localize an expanding lesion, all potentialities that might converge to tumor should be applied to the problem. I think that careful perimetric plotting would have aided localization in the first case. Quadrate defects should be looked for in such instances. In the presence of such nasal disease, I would first suspect an abscess in spite of the neurologic opinion. When in doubt, neurologists are too prone to fall back on the diagnosis of encephalitis. Increasing stupor and slow pulse (the latter certainly not typical of encephalitis) would indicate abscess. I would not have hesitated to explore the temporal lobe to eliminate the possibility of abscess. I was interested in the question of doing osteoplastic flaps for abscess of the brain. From the neurosurgical standpoint, this is the last thing the neurosurgeon would do, because this opens up a large field. If the patient dies, it is due to too much interference which had resulted in cerebritis. We believe that small trephine openings and the smallest drain should be introduced, the drain being allowed to remain so that the abscess is permitted to drain and collapse slowly. If the drain comes out there is no need to worry. We have done harm in being in too much of a hurry to get the pus out. These brain abscesses are extremely protean in their manifestations. We must exhaust all our resources to eliminate the possibility of brain abscess in such cases. If in doubt, a trepine opening should be made and one should plunge through a sterile field. If one does not find the lesion then, one may follow the neurologist's suggestion and consider encephalitis. The proper procedure is to wait until the abscess is well encapsulated and localized. Then drainage may be safely done without spreading infection from the drainage tract.

DR. BENJAMINE H. SHUSTER: In this case the mastoid was opened, trephining done and the dura opened after paralysis of the right third nerve and the left seventh nerve. Because of the depressed mentality and the localizing symptoms afforded by the nerve involvements, the brain should have been explored. Macewen has pointed out that the nuclei of the third nerve are within the crura within the temporosphenoidal lobe and are the first involved. Therefore, the procedure should have been to open up at that time.

Feb. 19, 1930

H. P. SCHENCK, M.D., *Reporter*

GEORGE M. COATES, M.D., *Chairman*

VASOMOTOR RHINITIS. DR. HAROLD G. TOBEY, Boston.

A wide divergence of opinion exists as to what clinical symptoms constitute presumptive evidence of vasomotor rhinitis. Since sneezing, rhinorrhea and nasal obstruction are the outstanding symptoms of vasomotor disturbances of the nose, a definition of these symptoms defines vasomotor rhinitis. Articles dealing with rhinitis, hay-fever, nasal hydrorrhea, paroxysmal hydrorrhea, hyperesthetic rhinitis, atopic coryza and allergic rhinitis describe a vasomotor condition of the nose, the exact nature of which is not definitely defined, and frequently the thesis becomes a frank discussion of true seasonal hay-fever or the relation of such nasal conditions to asthma. Dr. Tobey prefers the term vasomotor rhinitis because rhinitis suggests an inflammatory reaction. Many cases, of course, do not show typical acute inflammatory change. Perennial coryza is a good term but is newer and less familiar than vasomotor rhinitis.

At the time Dr. Tobey became associated with the clinic as a rhinologic consultant, the patients were put through a tedious siege of skin tests. Frequently the tests were all negative, and at other times patients with positive reactions failed to improve under treatment. Dr. Tobey found that while the symptoms in different persons were often alike, there was a difference in the appearance of the nasal mucous membrane. In the vasomotor cases that were allergic the membranes were apt to be pale, while in nonallergic cases the membranes were red and beefy. Great progress has been made in the knowledge concerning allergic cases, and many associations and a journal are now interested in diffusing information on allergic problems.

Vasomotor rhinitis may be divided into the allergic and the nonallergic types. A clear idea of what is meant by the term allergy is essential for a rational approach to this subject. Some neurologic diseases, such as angioneurotic edema or epilepsy, have been connected with allergy. Symptoms of gastro-intestinal and bladder disorders may be less characteristic. The history is of great importance, and the patient's observations are frequently important. Of the specific clinical tests, skin reactions have received the most attention, but they are by no means infallible. Occasionally the skin reacts to but one substance, and if that substance is rare, we may expect good results to follow its removal. Ophthalmic and nasal tests are also an aid in obscure cases, especially when we are dealing with dusts and pollens. The diversity of substances which may be a factor is evident when we consider that orris root, smoke, dust, foods, drugs and bacteria as well as the skin, roots and seeds of plants have frequently been shown to be etiologic factors. Insects, animal parasites, therapeutic serum, light, heat and cold are factors, and pregnancy, menstruation, nasal defects and functional disorders of the alimentary tract may influence the reactions.

Duke and Kyle point out the pale swelling which is so characteristic of vasomotor rhinitis, but it is not a common statement. The sneezing and pale swelling are associated with a clear, watery secretion, but the former may occur without

a pale mucous membrane. Secretion may vary from mere moisture to the outpouring of pints. Sinus obstruction and pain may result from the obstruction of the turgid turbinates. When it is associated with asthma, we usually suspect an air-borne substance and the chronic edema of air-borne cases frequently results in the presence of polypi. The duration of edema in the seasonal cases is too short to give this result. It is necessary to rely on the family history and the personal history and depend on the finding of some substance to which the person reacts to make the diagnosis.

Nonallergic cases may be due to extrinsic or intrinsic causes. Numerous illustrations of extrinsic causes occur in all occupations and especially in rubber industries, and in shoe and chemical workers. Direct irritation or reflex irritation may be due to factors within the nose itself (infection in the ethmoidal cells, swollen turbinates, deviation of the septum, infection in the frontal and maxillary sinuses).

The patients with vasomotor rhinitis due to direct irritation are the ones who are likely to benefit from surgical methods of treatment. In one case in which skin tests, endocrine therapy, cauterization and roentgen ray had been tried without improvement, exploration of the right antrum disclosed 2 drachms of straw colored fluid. The ostium was extremely small, being almost pinpoint in size with the mucous membrane immediately surrounding it definitely congested. An immediate cessation of all symptoms followed, and the relief has persisted for seven years.

Another case, that of a professor at Harvard, was characterized by sneezing and great rhinorrhea. The roentgenologist reported diffuse cloudiness of one antrum, but transillumination was good. On aspiration a cyst was found and emptied, and in twenty-four hours all symptoms had disappeared. On the recurrence of symptoms, a radical operation on the antrum was done, and a good part of the mucous membrane removed. There has been no recurrence for two years.

In the reflex irritation group, there must be included etiologic factors such as teeth, especially unerupted third molars. Dr. Sluder's method has been used in some reflex cases, but this has not been successful in my hands. In one patient in whom injection was made in such a manner, a severe hemorrhage was encountered so that thereafter I used the palatal route to reach the sphenopalatine ganglion. Three of such patients were benefited and three others failed to return for follow-up treatment.

Are the endocrine cases allergic or nonallergic? Theoretically they should be in the nonallergic class. Four of these cases showed pallor of the mucous membrane, while two showed no pallor, and of these six cases, five were ovarian and one pituitary. The pituitary case was unquestionably allergic. The pituitary gland may have had little to do with it, but the administration of pituitary extract was followed by improvement. This patient's father had epilepsy and her mother had asthma. The attacks began with migraine headaches followed by typical vasomotor rhinitis and later asthmatic wheezing. After many operations and removal of the tips of the turbinates, the pituitary extract was administered and relief was obtained. Another woman whose symptoms had started two years before at the time of a tubal pregnancy and hysterectomy, was immediately relieved when ovarian extract was administered. Cessation of the administration of ovarian extract was immediately followed by recurrence of symptoms. These could be controlled by again administering the extract.

Dr. Tobey agrees with Dr. Fink's classic description of the general pathologic picture observed in these cases and also with his theory of polyp formation. Dr. Tobey's rule for the past five years has been to consider surgical measures in the true cases of polyp formation with reddened mucous membrane. The red mucous membrane after seasonal hay-fever frequently continues through the rest of the year. In these cases submucous resection or the removal of a bulbous turbinate is of benefit in the allergic case. Infection of the antrum is also important.

In cases in which the membranes are pale and swollen, surgical measures should be attempted only as a last resort. Cocaine will not shrink the tissues. The polypi may be removed (true allergic polypi), but they will return.

At first these cases were referred to the allergists. Now allergy has outgrown the otolaryngologist. Allergy has become a specialty, and rightly so. However, the rhinologist should examine his cases and ascertain whether or not they are allergic. The pendulum now seems to be swinging the other way, and allergists are sending such cases to the otolaryngologist. Both investigators must work together, and much remains to be learned about its therapy, for the treatment of these patients is more unsatisfactory than that of treatment of patients having asthma.

DISCUSSION

DR. RICHARD A. KERN: There is little that I can say by way of amplification, and as an allergist I am a little one-sided. The patients whom I see have been referred to me by the otolaryngologist. I agree with Dr. Tobey's classification of the changes in the nasal mucous membrane. Such a classification has been of value in certain obscure conditions in which cough has been present. Bronchoscopic studies have revealed similar changes in the bronchial mucous membrane, and the pallid cases have frequently proved to be allergic. In ferreting out the causes of these conditions, the history is of the greatest importance, and there is no history more difficult to take. All ramifications must be considered: family history, climate, occupational contacts, diet, etc. Not only the obvious allergic factor but all other allergic manifestations must be investigated.

The interpretation of skin tests is of vast importance. A strongly positive reaction may indicate allergy but not absolutely. We must have clinical proof as well. The substance must induce attacks and its withdrawal should stop attacks. Moreover, sensitivity of the skin sometimes does not mirror the sensitivity of the rest of the body. Ragweed hay-fever may occur without skin or conjunctival reaction, but relief will follow treatment with pollen extracts. Frequently, patients will give a history of extensive nasal surgical treatment without relief. These are probably purely allergic cases. The degree of sensitivity may depend on the permeability of the nasal mucosa. An irritable state of the nasal mucosa, the result of contacts, etc., is accompanied by congestion which will make the mucous membrane at that point more permeable. Therefore, there is more absorption at that point; this is not only hypothetic. A person may be sensitive to a pollen and to goose feathers. His symptoms may occur only during the pollen season, but the administration of pollen extracts will not cure him. If we now remove the additional factor (goose feathers), a brilliant therapeutic success is obtained. At other seasons the mucous membrane is not sufficiently permeable to the feather factor. Infections of the upper respiratory tract may produce a similar phenomenon.

I should like to ask Dr. Tobey what percentage of the cases of vasomotor rhinitis are of the red mucous membrane type and of the pallid types. As a result of the congested and edematous change, polyps arise. Clinical and roentgenologic examinations of the sinuses are of importance. Surgical procedure should be the last consideration in treatment of patients with pallid mucous membranes. When there is an allergic basis, it is surprising how often a blocked sinus will drain of itself. I have often wondered why we have not seen more pituitary and adrenal cases, because extracts of these substances frequently are efficacious, and I have wondered why functional disturbances of these glands have not been described.

DR. H. P. SCHENCK: I have always felt indebted to Dr. Tobey for his publication in 1925 of the neurologic factors involved in vasomotor rhinitis. He has also performed a valuable service in being the first to point out the characteristic appearances of the nasal mucous membrane in such cases, thus bringing diagnostic order out of speculation. Considerable aid in diagnosis may be afforded by the cytologic study of the secretions in these cases. Eyermann has described eosinophils in such secretions, and I wonder what difference the secretions in the reddened type exhibit that the pallid type do not have. A simple

smear stained by Wright's method would be sufficient. The pathologic studies of such tissues describe the eosinophilic increase in the tissues, especially in the antrums in asthmatic patients. Here, the greatest collection of eosinophils appears near the mucous membrane. The increase of intercellular fluid has been noted, while the vascular channels appear unchanged. In cases of greater duration, polyp formation is the result of constriction of the venous channels by the weight of the edematous tissues, thus establishing a vicious cycle. Dr. Kern and I have recently studied the changes that occur in living preformed tissues in lower animals under the stimulus of allergens. Here the tremendous increase of intercellular fluid, probably serum and lymph, is startling. Its rapidity of appearance is difficult to conceive. In spite of the other tissue activity, the vessels do not dilate, but there is activity on the part of the arteriovenous anastomoses. Cytologic observations are of especial interest in such preparations. The Rouget cell, for instance, has been observed to become active and to approach vessels in its vicinity and apparently partially enfold the vessel. These phenomena are hard to explain with our limited knowledge. More observations on living tissues are required to advance our conceptions of the mechanism of allergy.

Dr. F. A. Murphy: What we need is something which will help us to separate the allergic from the nonallergic persons. An extract of human dander has been used to differentiate allergic from nonallergic subjects. I was interested in Dr. Tobey's differentiation between the reddened and the pallid types. I see these cases from the allergic standpoint and therefore am a little one-sided. I have two or three patients who were sensitive to a definite substance as shown by ingestion. Removing the substance from the diet was followed by disappearance of symptoms. One patient was later told to eat eggs because of a rundown condition, and the symptoms immediately reappeared.

Dr. Philip Stout: Regardless of whether a case is allergic or nonallergic, the antrums should be examined. In a surprising number of cases one or more polyps will be found. Their removal will give temporary or permanent relief.

Dr. Tobey: I was interested in Dr. Kern's remarks on bronchoscopic observations. I have not made a great many on these cases. I am not sure whether or not this pallor extends down into the bronchial mucous membrane. Most of those which I have seen were due to bronchiectasis. The relative number of cases in which the mucous membranes are pale and reddened is difficult to estimate because the mucous membrane does change. It may be red one time and white another, or it may show the pallid change in only a small area. Surgical measures in these cases should be attempted only when everything else fails. I have not seen any of the epinephrine cases. The bony changes are not well recognized, but they have been described in Dr. Beck's book. Dr. Murphy brought up Van Leeuwen's observation with human dander. I understand this is difficult of corroboration. The antrums are often washed as a matter of routine in our clinic.

Directory of Otolaryngologic and Ophthalmologic Societies *

NATIONAL

American Medical Association, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Robert C. Lynch, Maison Blanche Bldg., New Orleans, La.
Secretary: Dr. Gabriel Tucker, Bronchoscopic Clinic, University Hospital, Philadelphia.
Place: Detroit. Time: June 23-27, 1930.

American Bronchoscopic Society

President: Dr. Thomas E. Carmody, Metropolitan Bldg., Denver.
Secretary-Treasurer: Dr. Louis H. Clerf, 128 S. 10th St., Philadelphia
Place: Atlantic City, N. J. Time: May 27, 1930.

American Laryngological Association

President: Dr. Lewis A. Coffin, 114 E. 54th St., New York.
Secretary: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Place: Swampscott, Mass. Time: May 22-24, 1930.

American Laryngological, Rhinological and Otological Society

President: Dr. Ross Hall Skillern, 1811 Spruce St., Philadelphia.
Secretary: Dr. R. L. Loughran, 33 E. 63d St., New York.
Place: Atlantic City, N. J. Time: May 28-30, 1930.

American Otological Society

President: Dr. S. MacCuen Smith, 1429 Spruce St., Philadelphia.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.
Place: Swampscott, Mass. Time: May 20-22, 1930.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. William H. Wilder, 122 S. Michigan Ave., Chicago.
President-Elect: Dr. J. F. Barnhill, Miami Beach, Fla.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: Chicago. Time: October, 1930.

SECTIONAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frederick J. Wort, 1080 Broad St., Newark.
Secretary: Dr. Earl LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. John P. O'Keefe, 251 State St., Albany.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

New England Otological and Laryngological Society

President: Dr. Owen Smith, 690 Congress St., Portland, Maine.
Secretary-Treasurer: Dr. Stanwood Fisher, 192 State St., Portland, Maine.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Arthur C. Jones, 105 N. 8th St., Boise, Idaho.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.
Place: Victoria, B. C. Time: Sept. 4-6, 1930.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, Medical-Dental Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Fred Hasty, 119 Seventh Ave., Nashville, Tenn.
Secretary: Dr. Fletcher D. Woodward, Box 162, University, Va.
Place: Louisville, Ky. Time: November, 1930.

STATE

Colorado Oto-Laryngological Society

President: Dr. Frank L. Dennis, Ferguson Bldg., Colorado Springs.
Secretary: Dr. Rex L. Murphy, Metropolitan Bldg., Denver.
Place: Assembly Room of Metropolitan Bldg., Time: First Saturday of each month from October to May.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. George B. Smith, Rome.
Secretary-Treasurer: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. A. Van Osdol, 320 N. Meridian St., Indianapolis.
Secretary: Dr. Robert J. Masters, 23 E. Ohio St., Indianapolis.
Place: Indianapolis. Time: December 10 and 11, 1930.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. C. N. Spratt, 900 Nicollet Ave., Minneapolis.
Secretary-Treasurer: Dr. J. H. Morse, 80 S. 7th St., Minneapolis.

Montana Academy of Oto-Ophthalmology

President: Dr. Lee W. Smith, 125 W. Granite St., Butte.
Secretary: Dr. J. G. Parsons, Lewistown.
Time: Semi-annually.

North Dakota Academy of Ophthalmology and Otolaryngology

President: Dr. George M. Constans, Bismarck.
Secretary-Treasurer: Dr. F. L. Wicks, Valley City.

Oregon Academy of Ophthalmology and Otolaryngology

President: Dr. J. W. McCollom, 346½ Washington St., Portland, Ore.
Secretary: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland,Ore.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

President: Dr. J. E. Raia, 272 Broadway, Providence.
Secretary: Dr. F. W. Dimmitt, Jr., 195 Thayer St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

Utah Ophthalmological Society

President: Dr. F. M. McHugh, 17 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. W. Leroy Smith, Ezra Thompson Bldg., Salt Lake City.

Virginia Society of Otolaryngology and Ophthalmology

President: Dr. H. B. Stone, 303 First St., Roanoke.
Secretary-Treasurer: Dr. Fletcher D. Woodward, Box 162, University.

LOCAL

Atlanta Academy of Ophthalmology and Otolaryngology

President: Dr. Leon E. Brawner, 157 Forrest Ave., Atlanta.
Secretary: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta.
Place: Academy of Medicine, 38 Prescott St. N. E. Time: 8 p. m., last Thursday of each month.

Baltimore City Medical Society, Section on Otology and Laryngology

Chairman: Dr. Waitman F. Zinn, Medical Arts Bldg., Baltimore.
Secretary: Dr. Moses L. Breitstein, 1212 Eutaw Pl., Baltimore.
Place: 1211 Cathedral St. Time: 8:30 p. m., last Friday of each month.

Chicago Laryngological and Otological Society

President: Dr. Samuel Salinger, 25 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Austin A. Hayden, 25 E. Washington St., Chicago.
Place: Medical and Dental Arts Bldg., 185 N. Wabash Ave. Time: 6 p. m., first Monday of each month from October to May.

Cincinnati Oto-Laryngological Society

President: Dr. Harris H. Vail, 24 E. 8th St., Cincinnati.
President-Elect: Dr. Edward King, Pearl Market Bank Bldg., Cincinnati.
Secretary-Treasurer: Dr. Donald Lyle, 19 W. 7th St., Cincinnati.
Place: University Club. Time: 6:45 p. m., second Tuesday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. M. Paul Motto, Rose Bldg., Cleveland.
Secretary: Dr. A. D. Ruedemans, Euclid and E. 93d St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

College of Physicians of Philadelphia, Section on Otolaryngology

Chairman: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Clerk: Dr. Frederic M. Strouse, 1301 Spruce St., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., third Wednesday of each month from October to June.

COLUMBUS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

Chairman: Dr. John E. Brown, 370 E. Town St., Columbus, Ohio.
Secretary-Treasurer: Dr. Albert D. Frost, 681 E. Broad St., Columbus, Ohio.
Time: First Monday of each month.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. D. L. Bettison, Medical Arts Bldg., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, Medical Arts Bldg., Dallas, Texas.
Recording Secretary: Dr. L. A. Nelson, 4105 Live Oak, Dallas, Texas.
Place: Dallas Athletic Club. Time: 6 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DETROIT OTO-LARYNGOLOGICAL SOCIETY

President: Dr. C. C. McClelland, David Whitney Bldg., Detroit.
Secretary-Treasurer: Dr. Don A. Cohoe, 13535 Woodward Ave., Detroit.
Place: Maccabees Bldg. Time: Third Wednesday evening of each month from October to May.

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. W. R. Thompson, 510 Main St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, Fort Worth National Bank Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

HOUSTON ACADEMY OF MEDICINE, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. Claude C. Cody, 1306 Walker Ave., Houston, Texas.
Secretary: Dr. J. M. Robison, Eye, Ear, Nose and Throat Hospital, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Robert J. Masters, Hume-Mansur Bldg., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. L. R. Forgrave, Logan Bldg., St. Joseph, Mo.
Secretary: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

LONG BEACH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. W. B. Wright, Jr., 1209 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. M. A. Schurter, 114 E. 7th St., Long Beach, Calif.
Place: Pacific Coast Club. Time: Last Wednesday of each month from September to June.

LOS ANGELES COUNTY MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. A. Ray Irvine, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 727 W. 7th St., Los Angeles.
Place: California Hospital, assembly room. Time: 8 p. m., first Monday of each month.

Medical Society of the District of Columbia, Section on Ophthalmology and Oto-Laryngology

Chairman: Dr. Louis S. Greene, 1710 Rhode Island Ave. N. W., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month.

Memphis Society of Ophthalmology and Oto-Laryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

The Milwaukee Oto-Ophthalmic Society

President: Edward R. Ryan, 425 E. Water St., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 120 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. R. J. Warner, 706 Church St., Nashville.
Secretary-Treasurer: Dr. W. W. Wilkerson, Jr., Bennie-Dillon Bldg., Nashville.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

New Orleans Ophthalmological and Otological Society

President: Dr. William A. Wagner, Pere Marquette Bldg., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: January to June and October to January—third Thursday of each month.

New York Academy of Medicine, Section of Laryngology and Rhinology

Chairman: Dr. Mervin C. Myerson, 12 E. 86th St., New York.
Secretary: Dr. John M. Loré, 240 West End Ave., New York.
Place: 103d St. and 5th Ave. Time: 8:30 p. m., fourth Wednesday of each month from October to May.

New York Academy of Medicine, Section of Otology

Chairman: Dr. Clarence H. Smith, 2 E. 54th St., New York.
Secretary: Dr. James Garfield Dwyer, 57 W. 57th St., New York.
Place: 103d St. and 5th Ave. Time: Second Friday of each month from October to May.

Omaha and Council Bluffs Ophthalmological and Otolaryngological Society

President: Dr. Charles M. Swab, Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 1615 Howard St., Omaha.
Place: Medical Arts Tea Room. Time: 5:15 and 7 p. m., third Wednesday of each month from October to May.

Philadelphia Laryngological Society

President: Dr. Henry A. Laessle, 13th and Spruce Sts., Philadelphia.
Secretary: Dr. Herman B. Cohen, 13th and Spruce Sts., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., first Tuesday of each month from October to June.

Pittsburgh Otological Society

Chairman: Dr. John R. Simpson, 115 South Highland Ave., Pittsburgh.
Secretary-Treasurer: Dr. Watson Marshall, 121 University Pl., Pittsburgh.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. A. Vincent Walker, 833 South Ave., Rochester, N. Y.
Secretary-Treasurer: Dr. John F. Gipner, 53 Fitzhugh St., Rochester, N. Y.
Place: Rochester Medical Association, 13 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ear, Nose and Throat Club

Acting President: Senior member of the executive committee: Dr. F. C. Simon, Arcade Bldg., St. Louis, Mo.
Secretary: Dr. M. L. Hanson, Murphy Bldg., East St. Louis, Ill.
Place: University Club Bldg. Time: Third Wednesday in February, April, October and December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. F. W. Sorrell, Gibbs Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. A. F. Clark, 728 Main Street, San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

Spokane Academy of Ophthalmology and Otolaryngology

President: Dr. A. N. Codd, 421 W. Riverside Ave., Spokane, Wash.
Secretary: Dr. Marc Anthony, Old National Bank Bldg., Spokane, Wash.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. George H. Rockwell, Physicians Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubenstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

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